THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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(J. A. BERLY'S).

1911 EDITION

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EARNING POWER PER UNIT OF ROLLING STOCK.

AN article on the Earning Power of British Railways, which has appeared in two recent issues of the *Journal* of the Royal Society of Arts, might, with rather more aptness, have been given the title appearing above. While giving the receipts per train-mile, and per mile of line open, the author has taken as his main standards of comparison the gross and net earnings per locomotive, and the gross passenger traffic earnings per passenger vehicle and the gross goods traffic earnings per (company-owned) goods wagon.

The standards of comparison are not ideal, but short of the admirable detail which characterises the railway returns of one or two countries other than the United Kingdom ideal statistical standards cannot be obtained. Variations in traffic density, gradients, speed of service, efficiency of loading, idle-mileage, weight of trains, and power and conditions of engines on track, are all details which in their sum total determine the amounts of gross and net earnings respectively.

The author of the article gives a few figures for tube and other electric railways, but before we deal with these, it will be of interest to cite a few of the most striking of the figures given. Per locomotive (a term which covers everything from the heaviest of express engines down to light tank engines), the average of the gross earnings for England and Wales was in 1909 £4,715, the net earnings being £1,450. The gross earnings per passenger vehicle were £698, and per goods wagon, £85·5. In Scotland, gross and net earnings per locomotive were higher at £4,770 and £1,889 respectively, but for passenger and goods vehicles the gross figures were lower at £597 and £44·8 respectively.

The following table gives the figures for leading systems in 1909 :—

	Per locomotive. Gross.	Net.	Per vehicle—Gross. Passenger.	Goods.
London and North-Western	£4,965	£1,685	678	109
Midland	4,300	1,349	719	68·9
Great Western	5,005	1,729	828	99
Lancashire and Yorkshire	3,770	1,155	523	98·6
North-Eastern	4,918	1,680	704	59·2
Great Central	3,660	1,008	723	87·7
Great Eastern	5,040	1.443	564	90·9
South-Eastern & Chatham	5,930	1,859	813	96·4
London, Brighton & South Coast	6,030	2,110	766	87·6
London and South-Western	6,290	1,715	784	105·1
North British	5,230	2,220	516	43·4
Caledonian	4,760	1,826	758	42·5
Glasgow and South-Western	4,120	1,422	567	50·5

For the figures in the preceding four years, those interested should consult the *Journal* of the Royal Society of Arts. These serve to illustrate the trends of earnings on the various systems. Quite independently of power and cost of repairs, earnings per locomotive are mainly determined by the freight and passenger rates charged, and the effect of the competitive rival facilities of transport. The ratio of seating capacity to the dead weight of the passenger coach is of great importance. Many of the anomalies as to gross

earnings per passenger vehicle are due to differences in seating capacity, while in regard to goods wagons, these are not so much due to different carrying capacity as to the fact that the earnings from hauling privately-owned wagons are lumped under goods traffic. The total earnings, therefore, have been divided by the number of company-owned wagons, and the result taken as the earnings per goods wagon.

The peculiar conditions of the density of suburban traffic are the reason for the large earnings per unit of rolling stock on tube and suburban electric railways, where, as a general rule, on the modern large seating and standing room per coach, the net earnings per vehicle are about equal to the gross earnings on the leading steam-operated system.

The following figures relate to electric railways for 1909 :—

	Per passenger vehicle. Gross.	Net.
City and South London	1,087	—
Central London	1,294	521
Great Northern and City...	1,035	435
Waterloo and City	1,085	524
Liverpool Overhead	1,109	252
Mersey Railway	1,763	644
Charing Cross, Euston and Hampstead	1,402	628
Baker Street and Waterloo	1,667	881
Great Northern, Piccadilly and Brompton	1,423	765
Metropolitan	1,576	—
Metropolitan District	1,467	—

Commenting upon the last two systems, the article remarks that so far as these results go they indicate gross receipts per unit of passenger rolling stock almost as good as those on the older purely electric railways. Electrification has been a heavy expense, but one well justified in its fruits. The results for 1909 showed a perceptible improvement, while the results for 1910 are still more favourable. Had not this bold policy been adopted there is little doubt that the old steam-operated Underground, then almost moribund, would have rapidly become of merely archæological interest.

Electric tramway earning powers do not come within the scope of the article before us. Every electrical engineer is familiar with electric tramway returns, with their details such as receipts per car-mile, or consumption of energy per car-mile. For our main line and suburban railway systems we have no vehicle-mile figure. Passenger train-mile figures may cover anything from four to 14-coach trains. For contrasts therefore with railway figures both steam and electric, the comparison per car-mile does not apply. Therefore we have calculated from the returns of some leading municipalities the gross and net earnings per tramcar per annum.

	No. of cars.	Receipts per car. Gross.	Net.
Aberdeen Corporation	96	£747	£328
Belfast City Tramways ...	227	868	388
Birkenhead Corporation ...	120	467	172
Birmingham Corporation ...	300	1,218	519
Blackburn Corporation... ...	61	975	262
Bolton Corporation	192	624	245
Bradford Corporation	239	969	292
Cardiff Corporation	130	849	345
Derby Corporation	47	945	294
Dublin United Tramways ...	318	463	206
Glasgow Corporation	1,186	752	532
Leeds Corporation	282	1,213	580
Liverpool Corporation	546	1,031	312
London County Council ...	1,170	1,315	558
Manchester Corporation ...	536	1,444	496
Sheffield Corporation	268	1,066	395

The above figures vary even more widely than those per passenger vehicle on our railways. The effects of differences in type of car and in fares charged are, of course, greater on tramways than on steam railways.

Obviously, neither vehicle-mile nor vehicle-year is, by itself, entirely satisfactory as a standard of comparison, partly by reason of the wide range of types of varying weights and capacities, and partly by reason of the facts that (*a*) the unit of receipts per vehicle-mile is only an index as to the load factor when the car is in service, and takes no account of time spent in the sheds for cleaning or overhaul or in reserve, and that (*b*) the unit of receipts per vehicle per annum only covers total earnings, and is no index as to the efficiency of operation when in use. While it would add to the number of items in the statistical return of any tramway, there seems good ground for urging that both should be enumerated. Relative efficiencies of electric tramway systems could then be settled, not by fractions in the second decimal place as to higher receipts or lower expenses per car-mile, but where any number of places were being considered, with approximate equality ruling per vehicle-mile, a reference to the gross passenger receipts per vehicle per annum would be conclusive evidence as to the efficiency of capital expenditure. This last is no less important than efficiency in working.

Live Steam Feed Heating.

This subject continues to be debated in the *Engineer* by several correspondents, and one, Mr. Hamilton, of Belfast, is particularly sarcastic about Mr. Hall's breezy self-assertiveness. Now, nobody ought to be self-assertive on this question of live steam heating, for even if an economy is proved, the fact remains that the best economy possible is not so very easy to determine. So we get two opposing schools of opinion.

One denies the economy because it savours of making a profit out of the transfer of a sovereign from the left to the right pocket. But this is not argument. There must be some differential effect upon a fire-heated plate as between cold and warm water contact. The effects may differ much or little, but there will be a difference. Mr. Hamilton pins his faith on practice, and says that with live steam feeding steamers have saved 5 per cent. of fuel on the round trip to China and back, and mill boilers have realised 10 per cent. economy of fuel. We believe this to be due wholly or in part to the fact that the boiler plates transmit heat better when cooled by hot than when cooled by cold water. But our belief may not be well founded.

The economy which seems well proved in practice may be due entirely to the fact that the fully heated feed has some good effect in rendering the boiler *régime* more even, so that the pressure does not drop heavily at any time, and the firemen are less stressed and better able to maintain steam pressure at the economical height. But even this non-scientific explanation, if it states a fact, is good enough if the result is a saving of 5 per cent., even if not due to any very particular and curious principle of physics.

Meantime Mr. Hall, who, perhaps, has sufficient reason to make him annoyed with live steam heating, does not seem to be a disbeliever in what, to us, seems to be based on a similar physical principle—we mean the boiler tube with limited circulation, which works so cool. One correspondent points out very properly that all feed-heating is apt to show more economy than bald theory would show to be possible. Thus an economiser may be installed, and the additional feed temperature appears to be worth 15 per cent., but fully 20 per cent. of coal is saved. The simple explanation of the discrepancy may be simply that a stoker relieved of the worst 15 per cent. of his shovel-work does the remaining 85 per cent. at an improved efficiency equal to another 5 per cent., and so in the long run shovels only 80 per cent. of coal. Yet this same correspondent, who can see the possibility of a man being more efficient if eased of a little of his work, quite fails to believe that a boiler plate can be made to give out heat more efficiently to hot than to cold water.

If, as some would argue, the superior efficiency of evaporation with live steam heating is due to priming, this would exaggerate the loss of economy of coal. But live steam heating saves coal in practice, and can hardly therefore produce wasteful priming, for a wet engine is uneconomical. The same correspondent, who quotes *Ex nihilo nihil fit*, evidently has no notion of improved plate efficiency, or he would not regard live steam heating as an attempt at perpetual motion, as this quotation betrays him to do.

Meantime the combatants are getting as hot as live steam can make them.

We may add that the *Engineer* recently reprinted an old paper by Mr. Hamilton, containing very interesting figures on observed heat transmission to water when and when not in a state of ebullition.

The Marconi Patents.

While, in view of a possible appeal, we can say little by way of comment on the merits of the recent trial, we may at least congratulate Mr. Marconi on the remarkable victory which he has achieved; not only has his patent been adjudged valid and sound—a master-patent—but his position as the author of one of the most important advances in wireless telegraphy has been amply vindicated. The earlier stages of Mr. Marconi's work consisted mainly in combining certain known elements to form a practical working system, with which he succeeded in demonstrating for the first time the commercial possibilities of wireless telegraphy; to carry the matter further, however, to extend the range of the system, and to obtain the greatly desired syntony, an entirely new element was necessary. A perfectly definite problem confronted Mr. Marconi and the many other investigators who, attracted by his success, had taken up work in this interesting field; the problem was a difficult one, but, like so many others, was solved by what is now seen to be a comparatively simple device. The effect of this invention was immediately apparent; wireless telegraphy became commercially practicable, and its real progress dates from Mr. Marconi's patent of 1900.

The Telephone Service.

This being the last year of the old *régime*, it is quite natural that the opportunity should be taken by all parties interested in the public telephone service to give voice to their diverse views on the question of its future conduct and organisation. But having regard to the extremely complicated and highly technical considerations involved, it is somewhat surprising to note the assurance with which their opinions are formed and enunciated, often with a ludicrous assumption of omniscience and a total lack of the sense of humour.

What could be more absurd, for example, than for Glasgow, of all places, to assume the lead in marshalling the forces of the malcontents, in view of the notorious failure of the Glasgow municipal telephone service? We are reminded of the baboo who, in advertising for a post, appended the qualification "failed B.A." to his name, believing that short of passing the examination, failure to pass was the next best recommendation.

Fortunately, the Conference retained a measure of common sense, and recognising the futility of reviving the cry of municipalisation, confined itself to the demand for an inquiry into the whole question, before any increase be made in the existing charges, and for a reduction in the measured service rates. It is highly significant here also, that the Conference tacitly accepted the measured service system, for in the resolutions passed by the meeting, and submitted to the Postmaster-General, there is no demand for its abolition or for the adoption of the flat rate system. It should be added that out of the 400 or so corporations and boroughs of the United Kingdom, less than a quarter sent representatives to the Conference, and out of nearly 1,000 urban district councils only 36 were represented. Doubtless, all the great towns sent deputies (London accounts for 18 of the boroughs), but evidently the minor boroughs are not much interested in the matter.

Labour and the London County Council.

The relations between the London County Council and its contractors with respect to labour have formed in the past the subject of many heated discussions. The policy of using national or municipal work as a lever for the raising of the rates of payment made to workers is one which finds many opponents as well as friends. We have on many occasions strongly protested against labour conditions which have been proposed by the London County Council as well as by a large number of other municipal authorities, and have been pleased to note a more reasonable attitude being taken up by all parties as time went on.

In a recent report of the General Purposes Committee of the London County Council, the question was again raised in respect to work done outside a radius of 20 miles from Charing Cross. This recommendation only refers to work carried out for the Council by direct contract, and consequently does not apply to stores and materials purchased directly or indirectly by the Council.

The old arrangement, which has not been found very efficacious in practice, provided for the furnishing by the contractor of a list of rates of wages paid by him for work done by the Council outside the 20-mile radius, "which must be those at the date of the tender recognised by associations of employers and trade unions and in practice obtaining in the district in which the work is to be done." If this were not done, a money penalty for each infringement was provided for in the contract. It was found difficult in practice to determine what were the standard rates referred to in the contract, and for some time contractors have been called on to give an assurance in writing that the rates furnished by them were those in accordance with contract requirements. It is now stated on the authority of the solicitor to the Council that such an assurance is not definitely binding, inasmuch as it is not actually embodied in the contract. The General Purposes Committee have therefore adopted a clause which makes this assurance form part of the actual contract, and, moreover, provides for the automatic correction of the rates specified in the contract, if it should be proved to the satisfaction of the Council that the schedule rates are wrong.

The proposals provide for the alterations of several Standing Orders to allow of this alteration and the insertion in the standard form of contract of the following:—

All work to be executed under this contract by the contractor outside the radius of 20 miles from Charing Cross, in the County of London, shall be carried out at ——— in the county of ———, and at no other place except with the written consent of the ——— first obtained. The particulars of the rates of wages and the hours of labour to be paid and observed in connection with such work have been supplied to the Council by the contractor, and are set forth in Part 11 of the ——— schedule hereto, and are believed by the contractor to be correct. If, at any time during the subsistence of this contract, the Council shall give notice in writing to the contractor that it has been proved to the satisfaction of the Council that the said rates and hours are not in every respect in accordance with the rates and hours which were at the date of the contractor's tender recognised by associations of employers and trade unions, and in practice obtained in the district, then the actual rates and hours which shall be proved to the satisfaction of the Council to have been so recognised and obtained at the date of the said tender shall be considered as having originally been inserted in Part 11 of the ——— schedule in lieu of the rates and hours therein appearing, and the terms and provisions of this contract shall be construed and have force and effect accordingly.

There seems to be little in this alteration for contractors to object to, and we have no doubt that the modified clause will work smoothly in practice. It will be noticed that the rates are not those put forward either by employers or employed singly, but only those mutually arranged as standard by the two organisations and recognised as standard in the locality.

Electrical Production of Iron.—A considerable amount of interest has been manifested in Norway in regard to the trials made of the electrical extraction of iron from ore by the Swedish State near Trollhattan, and by the Stora-Kopperbergs Berglags Aktiebolag near Domnarfvet. When it was seen that the furnace of the Aktiebolaget Elektromotor which was used in the trials answered the purpose, the Norwegian interests proceeded to accelerate the completion of the electrical smelting plant which had been in course of construction for some months, and which is expected to be set in operation by the end of the current year. The working of the plant is to be taken over by the Hardanger Elektriske Jern-og-Staalwerk, which was recently formed with a share capital of £60,000. The plant will comprise two blast furnaces each of 2,900 H.P. and a steel furnace of 800 H.P., together with a rolling mill of an annual capacity of 6,800 tons of billets. A contract for 30 years has been concluded by the company with the Aktieselskabet Tyssefoldene for the supply of 4,200 H.P. at the price of £1 13s. 1d. per H.P. per annum, and the former has the right up to the end of 1912 of arranging for a further 10,000 H.P. at the same price for 30 years. A second plant for the electrical production of iron in Norway is projected by the Tinfors Poppersbruk which recently entered into an agreement with the Tinfors Jernoers Aktieselskab, in respect of the delivery of 10,000 H.P. at the rate of £1 2s. per H.P. per annum. The object is the manufacture and sale of iron and steel made electrically according to the system worked out by M. Lorentzen on a small scale at the Tinfors Poppersbruk. It is expected that the plant will be able to turn out 10,000 tons of iron per annum.

THE NEW ELECTRICITY IN MINES RULES.

The Report of the Electricity in Mines Committee is probably one of the most reasonable and fair-minded reports ever issued by a Government Departmental Committee. It is based on common sense, and a knowledge of both the conditions and requirements of the application of electricity to mining engineering, and will undoubtedly—by settling once and for all many points which were more or less unsatisfactory under the old rules, by removing fear, and restoring confidence amongst both owners and workmen—lead to its use being very greatly extended.

The Committee examined a number of witnesses appointed by the numerous technical institutions as well as the Mining Association of Great Britain and the Miners' Federation of Great Britain, and towards the end of the proceedings took into the Conference four Divisional Inspectors of Mines. Thus the evidence taken was thoroughly representative, and it appears to have been carefully weighed and considered, with the result that a set of rules has been proposed which will safeguard the owner from the too-economical manager and the jerry electrical contractor, and restore that confidence to the workmen which ought never to have been lacking had reasonable care, with a modicum of common sense, been taken in the installation of plant in the past.

As has been frequently pointed out in these columns, there never was any difficulty or danger in the application of electricity had reasonable and common-sense care been exercised in its installation, and it is pleasing to note that the Committee in their report confirm this view, as the following extract will show :—"Experience has shown that the *proper use* of electricity cannot be regarded *as inherently unsafe*, and that it possesses some characteristics which are of great advantage in underground conditions." (The italics here and in the following extracts are ours.) It must, of course, be admitted that during the last five years very great improvements have been made in electrical apparatus, and, moreover, manufacturers have become better acquainted with the conditions; but in spite of this we still maintain that there was no necessity for the large number of unexplainable accidents, which led up to almost a panic of fear amongst the miners, and amongst even some managers and owners, and they might have been avoided had electricity been *properly installed and used* from the commencement.

As regards accidents the report says: "The number of fatal accidents due to the use of electricity in mines in any one year has never reached a figure greater than 1·54 per cent. of the total number of fatal accidents in mines. This statement is necessary in order that the matter may be regarded in its proper proportion, *but it does not follow that the position attained is a satisfactory one.* On the contrary, *almost every electrical accident is preventable*, and as long as the accident list contains a proportion of preventable accidents there is room for improvement," which statement we heartily endorse. Further, "The feeling against the use of electricity in mines which found expression in some parts of the country was largely based, the Committee considers, either *upon a vague fear due to lack of knowledge*, or upon experience of the *behaviour of badly-constructed or badly-maintained* apparatus. The Committee knows of no place below ground in which electricity is in use to-day where both kinds of accidents would not be avoided *if the best* present-day practice as regards construction and maintenance *were complied with*." This, again, we can endorse and confirm.

Under the existing rules electricity can be used in *any part* of a mine, whatever the working conditions may be, but under the new rules its use is "prohibited in any part of a mine where on account of the risk of explosion of gas or coal dust such use would be dangerous to life." (See Rule 1.) At first sight this may appear to be a little hard on those collieries where electrical coal-cutters, for instance, are working in a thin gassy seam, but a little consideration will show that it is a wise precaution, as it will meet the wishes of a great many of the miners, and even many colliery managers, and will lead to the restoration of confidence and allow of the application of electricity to other parts of the same mine. Otherwise, so great was the objection of many of the miners becoming, that there is no doubt they would eventually have demanded its total abolition in all such mines. As things are, the rule is not absolutely positive, as it is provided that, "In case any difference of opinion shall arise between an Inspector of Mines and an owner under this rule, the same shall be settled (by arbitration) as provided in Sec. 42 of the Coal Mines Regulation Act." It is further provided, under Rule 2, that "Notice of the intention to introduce or add to or re-erect apparatus in any mine is to be sent to H.M. Inspector of Mines for the district, who may make such inspections or inquiries as he may consider necessary, and who must object, in writing, to its installation within one month from the receipt of such notice." Other notices to be sent to the Inspector relate to "notice of any existing apparatus," "notice of intention to introduce electricity into any mine where the use of electricity has previously been prohibited under Rule 1," and "an annual return, giving the size and type of apparatus," all of which may be considered by the colliery manager as more or less "red tape-ism," but which will undoubtedly ensure a little more attention on the part of the management, and inspire confidence in the workmen.

It is further to be noticed that the "revised rules," unlike the old rules, apply equally to *metalliferous mines* as well as coal mines, but *only apply* to the use of electrical apparatus *below ground*, with the exception of "such surface apparatus as may directly affect the safety of persons in the mine—for example, switchgear at the pit head for controlling the supply of current to the mine." Owners and colliery managers, however, would be well advised if they looked upon the rules as applying to every piece of electrical apparatus *on the surface*, as well as below ground. In fact, it is a little difficult to understand why the Committee do not think it necessary to insist upon the same standard of quality of apparatus, inspection and maintenance as is required below ground, seeing that in the Appendix B attached to the Report giving a list of fatal accidents between January 1st, 1905, and June 30th, 1910, out of a total of 68 accidents 13 are surface accidents, involving a loss of 14 lives. The following is a summary of fatal accidents due to electricity in mines from January 1st, 1905, up to December 15th, 1910 :—

	1905.	1906.	1907.	1908.	1909.	1910.	Total.
Number of deaths due to ignitions of firedamp...	—	1	—	—	9	—	10
Number of deaths due to underground fires ...	—	—	—	—	1	1	2
Number of deaths due to electric shock... ...	7	6	10	15	13	20	71
Total	7	7	10	15	23	21	83

With regard to the prevention of accidents, the report says :—"The possible dangers which may arise from the use of electricity below ground may be divided into (*a*) the risk of ignition of explosive gas, coal dust, or other inflammable material, as a result of open sparking, that is to say, sparking not confined within the apparatus itself, but such as would ignite inflammable gas *external* to the apparatus; and (*b*) the risk of electric shock." From the foregoing summary it will be observed that out of a total of 83 fatal accidents, only 12 are due to ignitions of firedamp and underground fires, whilst the remaining 71 are all due to electric shock, so that it would appear that the class of accident under (*a*) with proper care and improved apparatus may be eliminated altogether. In fact, many of the accidents recorded in Appendix B have been dealt with previously in these columns in some detail, and so far as the particulars given admitted, suggestions have been made as to how they might have been prevented. As regards accidents from class (*b*) it will be noticed that these are rapidly increasing, but there must also be taken into consideration the very great increase that has occurred in the same period in the installation of electricity, and if statistics were available as to the amount of horse-power installed, the figures would not appear by any means so alarming as they look.

(*To be continued.*)

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electricity from the Wind.

We have noticed with a little surprise Mr. Rankin Kennedy's article in last week's REVIEW, as he seems to be unaware of the existence of our wind turbine electric plants which have now been on the market for about two years. These plants have received favourable mention in your columns on more than one occasion, and we can only think that Mr. Kennedy has fallen somewhat behind the times in regard to "Electric Generators and Windmills." We have now about a dozen of our plants in operation in this country and abroad, all giving the greatest satisfaction to their owners, and our plants are in every way a commercial success. We may mention that a two million-dollar company has just been formed in New York for handling the manufacture of our plants in the States.

J. G. Childs & Co., Ltd.

London, N.W., *February 22nd*, 1911.

Electrical Cooking.

In the current issue of the ELECTRICAL REVIEW Mr. Morgan casually refers to my recent article upon the subject of electrical cooking, &c., and his remarks concerning heavier mains confirm my views of the importance of a constant load.

Cheap energy is a necessity if makers wish for a big business in the way of electrical cooking and heating apparatus. No station can afford to give even a reasonably cheap supply for short periods only; more particularly when the time of these intermittent calls coincides with that of peak load. As Mr. Morgan points out, extra load at certain times of the day means extra plant and heavier mains, which, of course, immediately puts the question of cheap electricity on the shelf. Small stations would feel the effect of a higher peak load more than would larger supply undertakings, and the small works want to level up their loads as much as possible, because frequently theirs is more of a private house demand than a factory one.

I hardly like again referring to the Therol system, but really something on those lines seems to me the best way to make a forward move in the direction of domestic uses of electricity in the day time.

Interested.

City and Guilds Examinations in Electrical Engineering.

Having read your correspondent "I.E.E.'s" remarks with reference to the City and Guilds examination, I am surprised to learn of the very small number sitting. Being one of those who passed this year second class, I may perhaps state that the paper appeared to me easier than last year (1909). I can hardly agree with him when he says that pass was a matter of chance. I agree *in toto* that technical institutes (evening classes) do not generally cater for the Honours student, the reason being, in my opinion, that very few students attend the advanced lectures on electrical engineering, hardly justifying the expense and attendance of a lecturer and special course of lectures.

Regarding the specialised paper, I agree that Secs. I and II were rather hard; but as regards Sec. III, Generation and Traction, any student who had attended an advanced course of lectures could have attempted four of the questions in this section. A great deal depended upon how the question was answered or the attempt made to answer it, hence the number of marks allotted accordingly; therefore I cannot agree that pass was a matter of chance.

The whole of the syllabus in many technical institutes requires revision in this subject.

P. Harris.

London, W.C., *February 27th*, 1911.

The Scarcity of Appointments.

I think that "Elektron" is wondering, like myself, what is wrong with the electrical engineering trade.

I can inform him that some resident engineers have been discharged from their stations, and one engineer now takes charge of two or three stations; also that some men have situations on short hours, and do work for wiring contractors in spare time; and some workmen boast of earning £3 a week and over, and do not forget to tell people about it, when they are only earning 30s. a week, and then there is a rush for the trade.

Magnet.

I have read with interest the letter appearing in the current number of the REVIEW, signed "Elektron," and can endorse from my personal experience every point he states.

I also am in the same position; through no fault of my own I happen to be out of a billet, the first time for 15 years, and although I answer all the advertisements in the technical papers, and I hold good certificates, not only am I unable to get any work, but in the majority of cases I cannot get even a reply. Applications at offices are generally met with the remark that instead of taking men on they are shortening the staff.

Another point is that I have a wife and family to keep, and although I am willing to go abroad, I find that there is another obstacle, in that most advertisements for appointments abroad now state that applicants should preferably be unmarried, and the age limit given is so low that few men can have had much experience of work outside this country.

I can only think that advertisers have had very little experience of work abroad, or are imbued with the following ideas: First, that married men, having home attractions, are less keen than bachelors to push any business which may necessitate their being away from their family for long; secondly, that there is no doubt that married men must be paid larger salaries than bachelors in order to be able to keep up their positions and to be able to make some kind of provision for the future.

This second condition is, no doubt, the chief cause of married men being barred, as most employers seem to be infected with the general craving for cheapness, which appears to be all-pervading at present.

I think a few words may be said in favour of the "Benedick," in that a firm has a much stronger hold on him, as he would be less likely to do anything that would put him amongst the unemployed, and also in order to keep his employment he would work his best all the time, it being much more serious for him to be out than for the bachelor.

Again, when it comes to the social side of the question, there is no doubt of the better value of a married man, as abroad, and more especially in the East, the personal element is of considerable value in obtaining orders, and the larger part of the social side is not done by the "lesser half." Should every line of business adopt this attitude towards the married man, it would be interesting to know what is to become of the nation in the future.

I should like to mention that I have been informed that recently the applications for two billets abroad, the pay for which was nothing very special, reached in one case nearly four hundred, and in the other two hundred; this seems to point to the fact that the electrical engineer considers the present state and the future prospects of the profession here to be so bad that it would be better to get away to some other country where there is some possibility of getting an appointment with prospects.

Batti-wallah.

Live Steam Feed-Water Heating.

Now the scent is getting hot, and I observe that a real live manufacturer is taking part in the discussion; but whether we shall get any "forrarder" is somewhat doubtful, for I fear he has come, not to elucidate matters, but to further complicate and mystify them. Look at the following list of performances which he puts in; are they not astonishing?

When live steam heaters are used:

(*a*) A greater quantity of heat units are absorbed by the water.

(*b*) Terminal temperature of boiler flue gases increased. Really?

(*c*) Coal consumption decreased.

(*d*) Temperature of economiser water increased by 10° F. to anything above.

(*e*) Last, but not least, the temperature of the superheater is also lifted in this wonderful cycle of operation.

Anyway, that is not a bad start for the manufacturer to give in the discussion on his part.

Let us analyse the performance. A live steam heater is used to give water at steam temperature, in consequence of which the heating surface has nothing in the world to do but to evaporate water (?), and in so acting the heater is so much absorbed in its task that it allows a lot of heat units to slip away out of the back door in the shape of higher terminal temperatures; to such an extent is the generosity of the heater displayed that it will add so much heat to the economiser that the water will be turned out hotter by 10° F. or anything above that!!! All this time the heater is also very busy reducing the coal bill, and writing out a testimonial for the superheater.

I am sure many of your readers will ask where would the economy have been if the economiser had been absent.

I have always been led to accept as fact that if a greater amount of heat is absorbed by the water, then the terminal temperature of the gases will be less; but when live steam heaters are used this appears to be reversed. "It's a werry won'erful fing," as the renowned Sam Weller would have said. I wonder what would happen if there were two heaters in a boiler.

I may, of course, be wrong, but many of your readers will think, with me, that the manufacturer, in stating such a lot, has fairly wiped the ground from under his own feet.

But, Sir, will anyone really and seriously believe such a yarn—that the system will reduce the coal consumption, at the same time increase the temperature of the terminal gases, cause the water to absorb more heat units, give a fillip to the economiser, and boost up the superheat? All I ask is—Is it reasonable?

This manufacturer admits many failures on the part of the system in the past, and states that "The comparatively few engineers who have extended experience in the application of live steam heaters have no difficulty in showing continuously economical results, but they would not think of putting heaters to work under conditions such as have been stated, and which have resulted in failure."

Well, if this manufacturer, who knows all about it, can put a heater to successful operation in a Babcock boiler, all that I have to say, after my experience, is that he ought to have a whacking big prize if he can get 5 per cent. economy, with or without the adjuncts above mentioned.

But, Sir, the manufacturer has given more away in the paragraph I have selected above than he imagines, for he acknowledges that some undefined but favourable conditions are required.

What is the use of discussing the matter any further, when an admission such as that is made? What I have contended for has been fully admitted in that paragraph by one of the high priests of the cult, and the fact is laid bare that in live steam heating there is *no inherent economy*, and it cannot be applied irrespectively to any boiler and economy obtained.

That is all I wanted to get from some maker, and I have got it. By trial and by investigation I found it out years ago, and I must, in conclusion, thank the gentleman for the admission.

After that, those who wish to take further part in the discussion can do so, but it is wasting valuable time.

John I. Hall.

London, W.C., *February 25th*, 1911.

By Appointment.—Messrs. A. P. Lundberg and Sons have received the honour of an appointment as electrical accessories manufacturers to His Majesty King George V. The firm previously held a similar appointment to his late Majesty King Edward VII.

ELECTRICITY IN MINES.

(*Concluded from page* 321.)

Memorandum. (*Abstract.*)

This memorandum is intended to deal with some of the practical points which may arise in connection with certain of the rules dealing with constructional and technical details.

Rule 7.—*Sub-Secs.* (*a*) *and* (*b*).—As apparatus is frequently placed in a confined space below ground and in charge of men without technical knowledge, commutators, slip-rings and all bare live parts should be avoided where possible. It is important that apparatus should be of mechanical strength sufficient to resist the rough usage liable to be received below ground by all machinery.

The choice of a motor (as, indeed, that of all apparatus) should not be made mainly from consideration of its price. The size of the bearings, the provision of ample clearance between the stator and the rotor, and the general mechanical construction of the apparatus should all be carefully considered. Preference should be given to well protected and well-impregnated windings, and to conveniently arranged and properly constructed and enclosed terminals or insulated connecting leads. Attention to these matters in the first instance, and to the proper installation of the apparatus, will result in lower maintenance costs, and at the same time promote safety by reducing the risk of breakdown.

Only lamps with hermetically sealed globes should be used in situations where there is risk of fire, or of danger from the presence of gas or coal dust.

A pressure test to earth and between conductors, equivalent to at least twice the maximum working pressure, should be applied as far as is practicable to all apparatus intended for use below ground. The same test should be applied in the case of repaired apparatus before it is again put into service.

The most useful instrument in connection with the periodical examinations, and any tests that may be necessary on low or medium pressure systems, is an ohmmeter, giving double the working pressure. There should also be available at every mine where alternating current is in use a portable testing transformer suitable for giving a number of voltages, the maximum to be not less than twice the highest working pressure in use at the mine. This apparatus can be used where, on account of the high pressure, an ohmmeter would be unsuitable.

Sub-Sec. (*c*).—If a system has one point intentionally connected to earth, the connection should be made to the earthing system, and not to a separate earth plate. Earthing the neutral point of a three-phase system is equivalent to earthing the mid-voltage point of a D.C. system, and with properly constructed apparatus the effect of both is to ensure that a circuit shall be immediately made dead by automatic switchgear (or fuses) in the event of a fault to earth on one pole of the system.

In a continuous-current system it is not desirable to earth the mid-voltage point unless cables provided with an efficient metallic covering are used. In a modern three-phase installation in which the apparatus and cables are carefully constructed and installed, it will usually be found desirable to earth the neutral point. In general the advantage of earthing the neutral point is increased by the use of cables provided with an efficient metallic covering.

Sub-Sec. (*d*).—The most efficient means of immediately indicating any defect in the insulation of a system is to arrange so that, in the event of any leakage of current, the faulty circuit shall be made dead automatically. This can be done provided one point of the system is connected to earth by one or other of the numerous automatic cut-out devices on the market.

Rule 8.—In many installations a separate small earth plate is sunk wherever there is any metal which it is desired to earth, there being no metallic connection between the different earth plates, but this method has so often proved itself to be unreliable in working that it is not admissible. The most satisfactory method is to use cables provided with an efficient metallic covering and to connect this covering to the earthing system at the surface, using it for all underground earth connections. Failing this, it is necessary to run a special earth cable throughout the installation connected to the surface earthing system.

It is advisable always to provide at least two plates, placed at some distance apart, but connected together. A cast-iron plate with projecting forks, to give a large contact surface, forms a good earth connection. Earth plates should not be less than 4 ft. square, placed preferably in an upright position in the ground, packed hard on each side with about 12 in. of broken coke. The depth at which they are buried must depend upon the condition of the ground in regard to moisture; the place should be carefully selected with a view to being permanently wet, or at least damp. The connection of the earth cable to each earth plate should be mechanically strong and electrically efficient.

The earthing of lampholders is not required where the pressure is less than 250 volts D.C. or 125 volts A.C. A pressure below 125 volts may be readily obtained on any A.C. system by using a small transformer for each lamp or group of lamps, and where these are used it will be found advantageous to transform down to 50 volts or less. The use of auto-transformers is not to be recommended for underground lighting. Where "open" wiring is adopted, a special earth cable should be run, or, alternatively, the lamp and holder should be enclosed in an outer globe provided with a porcelain top.

The use of strong glass outer globes is recommended in order to prevent lamp bulbs from touching brattice cloth or other readily ignitable material,

Sub-sec. (*b*).—All earth cables should have a conductivity at all parts at least equal to that of the largest conductor supplying the apparatus it is desired to earth.

Sub-sec. (*c*).—The connection with the metal which has to be earthed should be by soldered lugs and bolted connections which cannot accidentally work loose. The contact surfaces should be of ample area and faced, and when practicable, bolts of less than $\frac{5}{8}$ in. diameter should not be used. A good earth connection should be regarded as of even greater importance than a good connection in the supply circuit.

Rule 9.—*Sub-sec.* (*a*).—The voltage to be used in the smaller motors supplied from high and extra-high-pressure systems should be sufficiently low to ensure a thoroughly mechanical winding, with wires of a reasonable size, and as few conductors per slot as possible. At pressures in the neighbourhood of 3,000 volts, it is better to transform down for motors of 50 h.p. and under, and at pressures higher than 3,000 volts, it is probably better to transform down for motors of 100 h.p. and under.

Sub-sec. (*b*).—The best method of avoiding danger or of preventing leakage of current from the high-pressure side of a transformer to the low-pressure side, is to earth permanently some point of the lower-pressure system—in the case of a three-phase system, preferably the neutral point.

Rule 10.—A great deal of the switchgear used underground is not sufficiently strong, mechanically, to resist rough usage. Switchgear of the open type is not suitable for underground use. In general the design should be such that any fault or failure is under all conditions confined to the inside of the metal box or covering, so as to avoid all danger, and any risk even to the operator himself. Large open spaces inside switchgear casing should be avoided.

All insulators should be so constructed and protected as to prevent any diminution of the insulation by the lodgment of coal dust, dirt or moisture.

Though completely enclosed switchgear may be slightly more expensive compared with other forms of switchgear, it will require a minimum of inspection, cleaning and maintenance to keep it in good order, and it will thus in the end prove to be the cheapest to use.

It is important that switches should be so constructed as actually to make and maintain good contact, and that they should be so designed, constructed and adjusted that they cannot be left in partial contact or accidentally moved into contact when left out of contact. These are matters which can be decided from observation, and by almost anyone. The two extreme "on" and "off" positions should be clearly marked. Single-pole switches should not be used except on the concentric system.

Oil switches are at present, perhaps, the most reliable switches for use on high or extra-high-pressure circuits and for circuits of large power. The oil should be examined and renewed as often as is necessary to ensure at all times the absence of any deposit at the bottom of the tanks. It is essential that the oil tanks should be kept filled to the proper level. Where the parts are not so constructed as to resist any possible expansion of gases due to the opening of an oil switch on short circuit, suitable vent holes should be provided.

Where fuses are used, efficient enclosed fuses of the so-called "cartridge" type should be used, enclosed in properly constructed boxes. Every fuse should in itself be of such construction or so protected by a switch that it may be renewed without danger. Unless fuses are really proof against carelessness and improper use, as regards both open sparking and the possibility of shock, they should be protected on the live side by a switch breaking circuit on each pole.

As regards terminals, cable ends, cable joints and connections, total enclosure is of almost equal importance. In fact, such apparatus should be so designed and constructed that the least skilled person in the mine may safely be left without supervision in its neighbourhood, even when the pressure is switched "on."

Rule 11.—*Sub-Sec.* (*a*).—Lightning arresters, provided with properly constructed and properly connected reactance coils, are required where the supply of electricity is conveyed direct (that is to say, without transformation) to the shaft cables by an overhead line, so placed that there is risk of its being struck. If required by the conditions, lightning arresters should also be provided where underground telephone or signal wires are connected to surface telephone or signal wires. It is important that the earthing of lightning arresters should be efficient.

Sub-Secs. (*b*), (*c*) *and* (*d*).—All revolving apparatus should be capable of being stopped or started without difficulty, and the position of motor switches should be settled from this point of view. Subject to this consideration, they should be placed as near to the motor as possible. All pressure should be cut off from the apparatus, and in the case of motors, transformers, &c., from all apparatus in connection therewith. In the case of a motor this will include the controller or starting switch and any regulating resistances in connection with it.

Every installation should be provided with circuit-opening devices at certain points, designed and adjusted to open the circuit in the event of a fault or leakage of current. On high-pressure and on extra-high-pressure systems and for controlling circuits of large power below ground, switches fitted with automatic circuit-opening devices are essential. It is better to have one or two thoroughly reliable devices conveniently placed and arranged to cut off the current as quickly as possible from the whole or part of the system, rather than have such gear attached to every switch in the mine. It cannot be too strongly emphasised that all relays, tripping coils, and similar apparatus should be of sound mechanical construction, and so arranged that they cannot easily get out of adjustment. All switches controlled by automatic devices should be periodically opened by means of such devices, in order to make sure that all the mechanism and all the auxiliary contacts are in proper working order.

Rule 12.—*Sub-Sec.* (*a*).—A system partly concentric and partly two-wire should not be used.

Sub-Sec. (*d*).—Single-core armoured cables are not permissible, nor are separate pipes containing single-core cables. If single-core cables are put into iron pipes all the cables in the circuit must be enclosed in the same pipe. Where a number of insulated but unarmoured cables are brought together, their outer coverings should be fireproofed.

Sub-Sec. (*e*).—The amount of protection to be provided against the corrosion of cable armouring depends upon the amount of moisture present and the analysis of the pit water. In the case of a pit where gas may occur, the question of the most efficient metallic covering for the cables deserves the most careful consideration. A lead sheath is from many points of view to be preferred. If cables provided with a lead sheath and armouring are used, they will in general have a bedding of jute or other material between the lead and the armouring, and this also is to be preferred. Additional coverings, specially impregnated, may be necessary for cables working in wet places where the water is such that lead and iron are liable to be attacked by corrosion. Where it is not desired to use a lead sheath, double armouring with one or more layers of well water-proofed bedding between the two layers of armouring may be used. Where it is desired to use single armouring only, the conductivity and other requirements of an efficient metallic covering may be obtained by a copper sheath under the armouring, but well separated from it by moderately thick bedding. The important point is that in order effectively to avoid open sparking the metallic sheath nearest to the conductors should be air-tight, as is a lead sheath, or it should be enclosed by other sheaths, designed to prevent an arc from penetrating to the outside of the cable.

In general, wire armouring is to be preferred for use below ground to tape armouring, and double armouring to single armouring.

Sub-Sec. (*f*).—Clause (i) provides for the use of terminal boxes or sealing chambers to protect and seal off the end of the insulation where cables are cut off for joining to apparatus—a precaution which has very commonly been neglected in underground work in the past, in spite of the fact that proper protection at such points is called for by Rule 25 of the Code of 1904. Proper protection is best effected by a sealing chamber dividing box. In many cases the sealing chamber may be advantageously combined with the terminals of the switchgear, motor, or transformer, thus tending to reduce and simplify apparatus. Clause (ii) provides for the mechanical protection of cables where they are joined up to apparatus. The ends of armoured cables should be finished off by securing the armouring to a spigot, or to a gland screwed into the switch-box or cable dividing box, the object being to provide mechanical protection for the insulation of the cable throughout its whole length. The common practice of simply cutting off the armouring of a cable one or two inches back from a motor case or a switch box, leaving short lengths of unprotected cable, would not comply with this rule.

The metallic sheaths of the cables must always be bonded independently of joint-boxes; the bond may cross either inside or outside the joint-box, but each separate metallic sheath should be separately bonded.

Rule 13.—Portable apparatus may be made secure from the risk of dangerous shock on all a.c. systems by transforming down the pressure for use to a voltage such that the pressure between any conductor and earth is not greater than, say, 125 volts. It is recommended that this should be done where practicable.

Sub-Sec. (*a*).—Flexible cables for portable apparatus should be tested to four times the working pressure before being put into service, both when the cable is new and after it has been repaired. Metallic covering for flexible cables is not, as a rule, desirable.

Sub-Sec. (*b*).—By "properly constructed connector" is meant one which may be used without danger. There should be no danger from exposed conductors whether the connector is in or out of use, or from overheating due to loose contacts, and there should be no danger to the user when plugging in or out. To obviate the latter the pressure should always be switched off the connector before the plug portion is either inserted or withdrawn. With portable apparatus the connector may have to provide for the earth connection in addition to the circuit connections. It should be so arranged (1) that in plugging in and out, the earth connection is made before, and broken after, the circuit connections, and (2) that, in plugging in, the connections cannot be wrongly made. It should not be possible to put the earth contact of the plug portion into connection with a live contact of the socket portion, as the metal work of the portable apparatus would then be made live, very possibly bringing about just such an accident as the earthing is intended to prevent. The plug should be locked in position when in use so that it cannot be accidentally or inadvertently withdrawn when live.

In another Appendix a list of fatal accidents resulting from the use of electricity in coal mines, from January 1st, 1905, to June 30th, 1910, is given, with brief particulars of the circumstances.

Underfeed Stokers.—Among recent orders for stokers, &c., supplied by the Underfeed Stoker Co., are the following:—Bradford Corporation Sewage Works, two B 5; Antwerp Electric Station, eight "E,"

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Link Insulators for High Pressures.

An article in the *Génie Civil* recently described a new form of suspension insulator invented by Messrs. Vedovelli, Priestley and Co., of Paris, and known as the "link" type, which is about to be installed on a 45,000-volt line in the north of France. A single link is shown in fig. 1, and a complete chain in fig. 2, while fig. 3 shows its application to the suspension of a three-phase line; as the chain can be placed in any position—this being one of its characteristic advantages—it lends itself to a variety of uses in addition to the one illustrated. Each link is connected to the adjoining links by a ligament of galvanised steel wires, in such a way

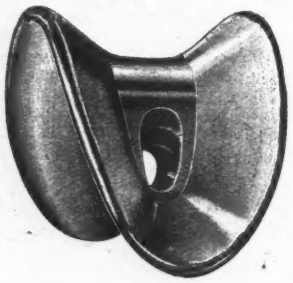

Fig. 1.—Link Insulator.

that the insulating material is placed in compression, so that the tensile strength of the chain is very great. When the chains are used in the vertical position as shown, galvanised iron sheds are provided at the top of each length to throw off rain-water. A simple attachment is provided for the line wire, and the lower end of the chain is firmly anchored. The intervals between the links can be varied as desired, the greater lengths giving the higher breakdown values for a given number of links; thus, tests made under a very heavy oblique artificial rain resulted in breakdown at 90,000 volts with eight links spaced 50 mm. apart,

Fig. 2.—Chain of Link Insulators.

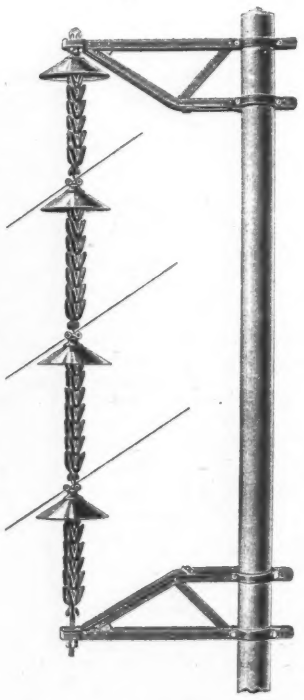

Fig. 3.—Three-phase Line carried on Link Insulators.

while six links spaced at 90 mm. intervals withstood nearly the same pressure. The same chain was tested in both horizontal and vertical positions under the shower, and six links gave a limiting pressure of 90,000 volts in the former, 80,000 in the latter. A chain of eight links was found to have a capacity of 80 millionths of a microfarad. For pressures up to 20,000 volts, the cost of a transmission line insulated on this system is said to be comparable with that of a line carried on ordinary insulators; beyond that limit, the saving increases with the rise of pressure, while at lower pressures the increased security, it is claimed, is well worth the somewhat higher cost.

These insulators have been used on the North-South Electric Railway, of Paris, in the tunnel under the Seine, and will shortly be installed on the electric railway of the Mure, Isère; they have also been employed on the single-phase railway of the South of France at 6,000 volts, and will be adopted for the Midi Railway at 15,000 volts. They are made in various sizes, that of which data are given above having a weight of about ½ lb. per link, and a tensile strength of two tons. Messrs. Laing, Wharton, Ltd., of 7, Great Newport Street, London, W.C., are the agents for this country.

Remote Control Switches.

The Adams Manufacturing Co., Ltd., of 106, New Bond Street, W., have brought out a series of "Adams Igranic" clapper and contactor remote control switches, a pair of which are illustrated herewith. These electrically-operated switches have been

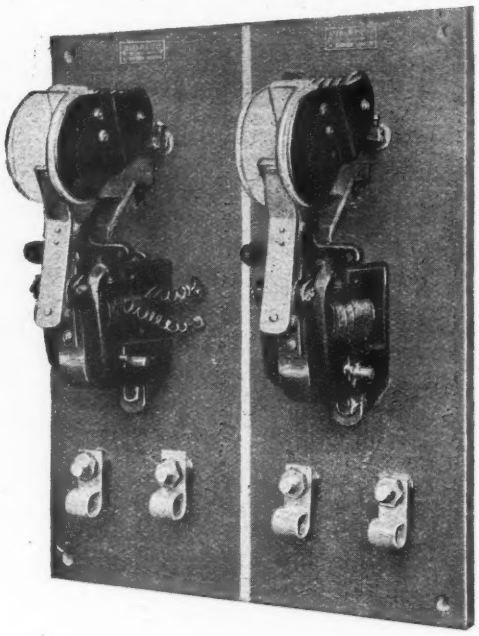

Fig. 4.—Adams Igranic Remote Control Switches.

primarily arranged for circuits carrying large currents, which may easily be controlled from a distance without the use of heavy conductors, thus necessitating the use of leads only sufficiently heavy to carry the magnet energising current, a considerable saving resulting in cables and labour. The main circuit is carried by laminated copper brushes, and all circuit making and breaking is taken on copper and carbon sparking tips, easily renewable, and protected by powerful magnetic blow-outs. The switches are standardised from 5 to 10,000 amperes on voltages up to 600 volts.

New Grid Resistance.

A new patent corrugated resistance has recently been brought out by Messrs. Clarke, Chapman & Co., Ltd., of Gateshead, designed to obviate the defects inherent in the cast-iron grid. The chief defects of the old-fashioned type are that they are easily broken, they are very springy in the small sizes and consequently are liable to "short" on to one another if subjected to vibration, they are very heavy, they have a considerable temperature coefficient, and they can only be made in comparatively small sizes. All these defects are overcome in this new unit, which is shown in fig. 5, p. 337. The units are built up of long lengths of strip which have holes punched at certain distances apart. The strips are then doubled up and the corrugations all performed at one operation. All the turns of a unit are supported upon a single rod, and from the fact of this being in the centre of the turns it follows that every turn is free to expand and contract independently of any other turn.

On account of the very large surface of the strip as compared with the cross-sectional area, these resistances dissipate their heat very quickly and are consequently of special advantage where they can be mounted in well ventilated frames or where they will be subjected to a draught. For the same reason they are very suitable for resistances immersed in oil or water. The construction of the units enables repairs to be effected easily and cheaply, and it is not necessary to scrap a damaged unit, as is the case with cast-iron grids. The strip is insulated from the binding rod by means of a mica or micanite tube; and even though the unit should be run red hot, this tube will stand quite well. Between turns only pure mica washers are used for insulation. The units are arranged for mounting on two insulated rods, which can be placed vertically or horizontally in exactly the same manner as grids are mounted, and they

can be coupled up in single series or any number in parallel as required. Units can be supplied with tappings taken off anywhere along the clamping rod. This is done by inserting a strip in the desired position, and then bending it and carrying it along to one of the mounting rods; if the connection is long, it is corrugated in a similar manner to the resistance strip itself, to give it rigidity.

The unit illustrated shows one terminal turned upwards and one down; this course is usually pursued where the grids have to be arranged on vertical mounting rods, and the object is to get the

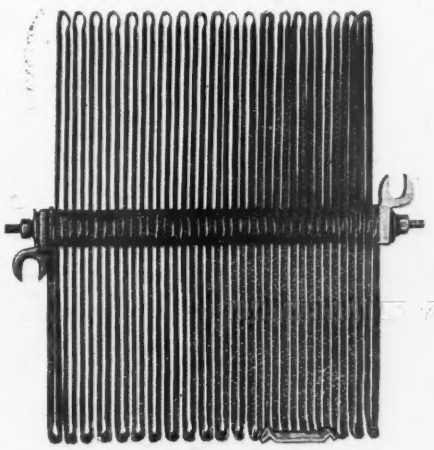

Fig. 5.—New Form of Grid Resistance.

two sides of the unit as nearly balanced as possible. The view also shows a short section of strip at the foot of the grid turned so as to show the cross-section of the strips used. The units standardised so far vary from 500 to 300 watts each, continuous rating, and the current range is from 25 amperes in the smallest to 82 amperes in the largest single unit. The resistance material is a special alloy, which is non-corrodible, and has practically no temperature coefficient. Units of the same dimensions as the above, but of ordinary mild steel galvanised, can be provided; but the smallest of these are for about 40 amperes. Units of the special alloy smaller than the 25-ampere size and larger than the 82-ampere size mentioned above are in course of standardisation.

Variable-Speed Induction Motors.

The British Thomson-Houston Co., Ltd., of Rugby, have recently built several induction motors for variable-speed drive, and the accompanying diagram, fig. 6, shows characteristics obtained from actual tests on a three-speed machine of this type.

This machine has two windings on the stator, one being suitable for either 4 or 8 poles, while the second winding is arranged for one number of poles only, viz., 12. The number of poles of the stator is varied by means of a throw-over switch. On a 50-cycle circuit the

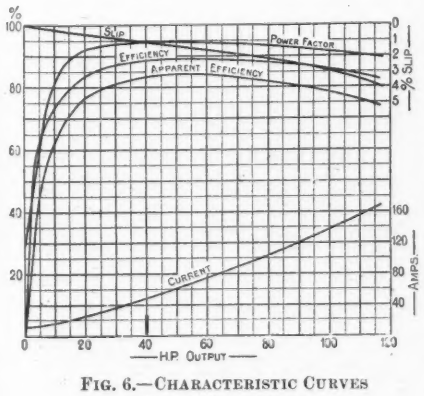

Fig. 6.—Characteristic Curves of Three-Speed Motor.

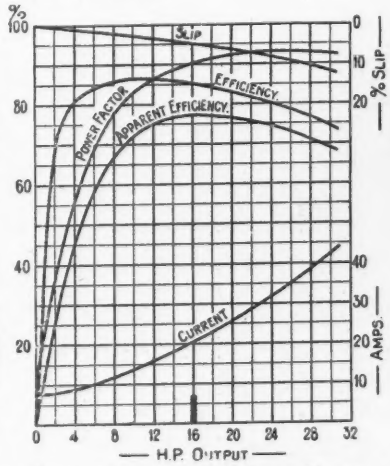

Fig. 7.—Curves of Two-Speed Motor.

B.T.-H. Variable-Speed Induction Motors.

synchronous speeds were 1,500, 750, and 500 r.p.m., the corresponding full-load speeds being 1,485, 735, and 490 r.p.m. The horse-power ratings corresponding to these speeds were 40, 20, and 14 respectively. The efficiencies at the lower speeds were practically the same as at the highest speed.

Fig. 7 shows the characteristic curves of a two-speed squirrel-cage motor. As this machine was required to be arranged for synchronous speeds of 500 and 375 r.p.m. on a 25-cycle circuit, this necessitated the number of poles being six and eight respectively, so that a straightforward two-to-one pole-change winding could not be used. Two windings were therefore put into the stator slots. Fig. 8 shows the general appearance of this machine. A throw-over switch is mounted on it for changing over from one winding to the other, three terminals being brought out to the line.

While the above type of machine, having several definite speeds, meets the requirements in most cases, it is, however, desirable occasionally to have a machine suitable for operating at any speed from the maximum down to 15 per cent. or 20 per cent. above zero speed. To use an ordinary slip-ring motor with resistances inserted in the rotor circuit to give the total speed variation required is very inefficient; much more efficient working can be obtained by

Fig. 9.—B.T.-H. Variable-Speed Induction Motor.

building the motor with a changeable pole stator winding and also a changeable pole rotor winding. A straight two-to-one ratio requires only a single winding on the stator and a single winding on the rotor. A simple throw-over switch is all that is necessary to change the speed from full speed to half speed, and at both these speeds a highly efficient machine is obtained. To obtain any speed between full speed and half speed and zero speed it is necessary to insert resistance in the rotor circuit, but it will be readily seen that the losses in reducing the speed of this type of machine down to, say, 25 per cent. of maximum speed, are much less than if resistances had to be introduced to provide for the complete reduction in speed from full speed down to 25 per cent.

Fig. 9 shows such a machine, built at Rugby by the British

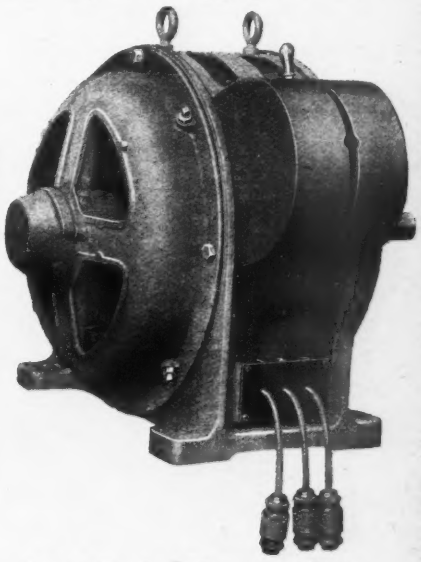

Fig. 8.—Two-Speed Induction Motor.

Thomson-Houston Co., Ltd. The rotor is wound six-phase, and is provided with six slip-rings. No other switching device except the usual controller is necessary in the rotor circuit. The machine shown was built with windings arranged for 8 and 16 poles, to give synchronous speeds of 600 and 300 r.p.m. respectively on a 40-cycle circuit, the outputs at these speeds being 15 and 7½ h.p. respectively. A 40 per cent. speed reduction below maximum and the same below half speed was required. The starting characteristics of this machine are similar to those of an ordinary slip-ring motor.

Siemens Portable Cells.

In a recent publication (Catalogue No. 531) Messrs. Siemens Bros. & Co., Ltd., of Caxton House, Westminster, give particulars of a wide variety of primary cells, including some portable

Leclanché cells for firing shots, submarine mines, &c., and for field telegraphs. These cells are made up in sealed ebonite cases; they are usually of the agglomerate block type, and contain a charge of sal-ammoniac, so that on the addition of water, they are ready for use. Fig. 10 shows the oblong pattern of firing cell, and fig. 11 a portable telegraph or testing cell, with rubber strips at the bottom and sides to protect it against rough usage. The former

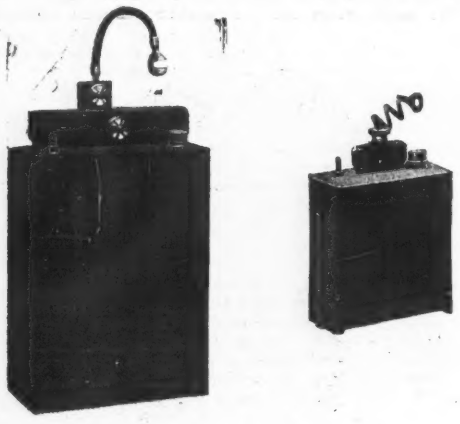

Fig. 10. Fig. 11.

Siemens Portable Leclanche Cells.

are of low resistance, and weigh about 7 lb., while the latter are made in two sizes weighing ¾ lb. and 2 lb. respectively. Either type can be supplied made up in batteries in wooden cases.

BUSINESS NOTES.

Coronation Illuminations.—A week or two ago the *London Gazette* contained full lists of the various firms and individuals who are suppliers by special appointment to the household of His Majesty King George V. We would suggest to electrical contractors and others that these, at any rate, may be regarded as among the most certain to be requiring illuminating work for their building fronts at the time of the Coronation.

Messrs. W. Leonard & Co., 4, Soho Street, W., have issued a circular relating to their new kaleidoscopic electric signs 3 ft. and 4 ft. diameter suitable for Coronation illumination purposes: also a list of the "Leonard" patent lighting strip.

Book Notices.—"*Journal* of the Western Society of Engineers." Vol. XVI, No. 1. January, 1911. Chicago: The Society. Price 50 c.

"The Gyroscope." By V. E. Johnson. 1911. London: E. & F. N. Spon, Ltd. Price 1s. 6d. net.

"*Journal* of the Franklin Institute." Vol. CLXXI, No. 2. February, 1911. Philadelphia: The Institute. Price 50 c.

"Atti della Associazione Elettrotecnica Italiana." January, 1911. Milan: The Association.

"Le Facoltà Radiative delle Antenne." By Dott. P. Barreca. Extract from the "Atti della Associazione Elettrotecnica Italiana," Milan.

"Green Book of London Society, 1911." London: J. Whitaker and Sons, Ltd.

Electrical Show at Boston, U.S.A.—The Edison Electric Illuminating Co., of Boston, are running an electric show from September 28th to October 26th, 1912, and they want information from firms everywhere concerning electrical appliances for light and power in every trade, industry and field so as to enable them to make the exhibition complete

Private Meetings.—The Howe Electrical Engineering Co., Ltd., Liverpool.—In pursuance of Sec. 188 of the Companies' (Consolidation) Act, a meeting of the creditors of the above was held a ew days ago, the meeting having been called by Mr. Arthur Thraves, C.A., Liverpool, who had been appointed to act as the voluntary liquidator of the company by the shareholders. According to the statement of affairs submitted the liabilities amounted to £1,326, of which £1,171 was due to trade creditors, and £155 to cash creditors. The assets were estimated to realise £873, from which had to be deducted preferential claims of £109, and a debenture of £500. The net assets were thus reduced to £264, and a deficiency was disclosed, as regarded the unsecured creditors, of £1,062. The debenture for £500 was held by the London and Provincial Bank. The liquidator, in answer to a creditor, said he had every reason to believe that with careful management the assets would realise the amounts at which they appeared in the statement of affairs. The company was formed in October, 1909, with a nominal capital of £5,000. Fully paid shares of the face value of £2,400 were issued to the vendors in part payment of the assets acquired by the company. There were three directors of the company, and it was arranged that they should each draw £3 10s. a week, and 10s. weekly for expenses. Two of the directors conducted the business at Liverpool, while the third directed the affairs of the branch at Blackburn. Since the incorporation of the company the wages had totalled £1,600, while the salaries had been £990, and the general expenses had been nearly £600. After discussing the position, a resolution was passed in favour of the appointment of a joint liquidator, but no creditor was nominated to make the necessary application to the Court. A committee of three of the principal creditors was nominated. The liquidator stated that he had been appointed to act as receiver on behalf of the debenture-holders, and was proceeding to realise the assets. He estimated that if no further costs were incurred there would be a small dividend to come to the unsecured creditors.

Oswald Hamilton, hardware and electric merchant, Richmond Street, Londonderry. A meeting of the creditors of the above was held recently, when it was decided to realise the estate. The liabilities in the matter amount to £856, and the assets to £155.

Meeting of Creditors.—The *Review of the River Plate* for February 3rd states that Messrs. Buchanan, Jordan & Co., importers of electrical and other goods, have called a meeting of their creditors. Assets figure at $1,135,152 and liabilities at $1,124,713.

For Sale.—Mr. H. Toner, Liverpool, will, on March 8th and 9th, sell by auction the electrical stock of Messrs. Whipple and Co. See our advertisement pages in this issue.

Dissolutions and Liquidations.—Macfarlane Electrical Co., electrical importers and exporters, 17, Boyson Road, Walworth.—Messrs. W. Burke and G. Frizell have dissolved partnership. Mr. Frizell will continue the business under the same style and Mr. Burke will attend to debts, &c.

The United Kingdom Tramway, Light Railway and Electrical Syndicate, Ltd.—A meeting is to be held at 4B, Frederick's Place, Old Jewry, E.C., to hear an account of the winding up from the liquidator, Mr. G. E. S. Venner.

United Asbestos Co., Ltd.—A meeting is called for March 30th at 4, Moorgate Street, E.C., to hear an account of the winding up of this company, which is now amalgamated with Bell's United Asbestos Co., Ltd.

Messrs. D. Selby Bigge & Co., electrical engineers and contractors, Newcastle-on-Tyne, London and Glasgow.—Messrs. D. L. Selby Bigge & R. G. Bell have dissolved partnership. Mr. Selby Bigge attends to debts.

Messrs. Watlington & Co., electric tramway supply merchants, Moorgate Station Chambers, E.C., and Trafford Park.—Messrs. V. Watlington, J. F. Caine & S. C. Hackney have dissolved partnership. Messrs. Watlington & Co., Ltd., will attend to debts, &c.

Catalogues and Lists.—The Sun Patent Evaporator Co., Ltd., 428, Tower Buildings, Water Street, Liverpool.—Catalogue containing a full description of their "Sun" patent turbo pump with renewable liner, and its advantages.

Messrs. Bagshawe & Co., Ltd., Dunstable.—Leaflet illustrating and pricing their Gray's style chains and attachment links and sprocket wheels therefor.

The "Z" Electric Lamp Co. have issued a wall showcard, which is effectively produced in eight colours, and which should serve to emphasise in the mind of the public the fact that the lamp is British made. The lamps are "all-British," from the extracting of the metal to the formation of the filaments right up to the manufacture of the lamps, in which English glass is almost entirely used. The "Z" lamp is fully protected by British patents, the validity of which has been upheld in the High Court and in the Appeal Court. Copies of the showcard can be obtained by anyone in the trade who is interested. Space is left at the bottom for agent's name and address.

The Adams Manufacturing Co., Ltd., Bedford.—Illustrated price list No. 3 describing oil-immersed "Igranic" switchgear, circuit breakers, starting switches for use with auto-transformers, and double-throw automatic oil-immersed starting switches. Illustrated and priced circular of multiple switch starters, resistance units, "Igranic" lifting magnets, and other manufactures.

Mr. James A. Higgins, Nelson, Lancs.—Folding price circular of knife switches, tubular fuses and indicating cartridge fuses.

Messrs. Wailes, Dove & Co., Ltd., London.—Circular relating to their "Bitumastic" enamel solution which is being satisfactorily used by a large electricity supply company for its steel smoke-stack, and has also been used for some years for large railway structures, &c.

Mr. R. H. Haylock, 63, Queen Victoria Street, London, E.C.—Leaflet describing, and giving prices of, the "Excelsior" quick-chain hoist.

The British Aluminium Co., Ltd., 109, Queen Victoria Street, London, E.C.—Reprint from a contemporary of an article on aluminium *v.* copper cables for low-tension feeders and distributors.

The British "Niclausse" Boiler Co., Ltd., Caxton House, Westminster, S.W.—28-page catalogue (well illustrated on art paper) describing the principles of construction of the Niclausse water-tube boiler, a summary of its advantages, and a list of standard sizes. Superheaters and Niclausse automatic stokers are also particularised. Several pages are occupied with drawings of a number of large French electric power stations where this type of boiler is used, and with information relating to the boiler's use in marine service.

Messrs. Verdon Cutts & Hoult, 87, Fargate, Sheffield.—16-page pamphlet describing the electrical manufacture of steel in the firm's electro-Bessemer furnace. Electric welding, annealing furnaces and electric Borchers' furnaces for experimental furnaces, are also referred to in the course of its pages.

General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—New edition of their "Geekoduct" conduit and accessories catalogue. The contents mainly consist of a variety of small illustrations, accompanied by a great deal of clearly-arranged tabular matter relating to prices, sizes, &c., of conduits, switches, boxes, brackets, ship lanterns, also tools and sundries required in conduit installation work.

G.m.b.H. Classen & Co., Barbarossastrasse 16, Berlin W.30.—New price-list of Fludor soldering materials, including particulars of their latest novelty, Fludor quick solder, consisting of collapsible tubes of powdered solder mixed with Fludor soldering flux, which combines the advantages of the hollow solder filled with Fludor paste and the convenience of the squeeze-out method.

Bankruptcy Proceedings.—Edward Surtees, electrician, South Shields.—At the Newcastle Bankruptcy Court on February 23rd, this public examination was heard. The gross liabilities were returned at £151, of which £140 was expected to rank. The assets were estimated at £39, leaving a deficiency of £101. The debtor alleged bad trade and heavy County Court and other legal expenses as the cause of his failure. He commenced business seven years ago, and was without capital. On January 9th, 1906, he executed a deed of assignment to a trustee for the benefit of his creditors, and paid 10s. in the £ on £99. The examination was adjourned until March 2nd.

A. D. Poulter, "printer and electrical engineer," Surbiton.—Last day for receipt of proofs for dividend, March 4th. Trustee, Mr. H. L. Howell, 132, York Road, S.E.

A. J. Hollington, electrical engineer, Walbrook, E.C.—First and final dividend 1s. 2d. in the £ payable at Bankruptcy Buildings, Carey Street, W.C.

J. M. Vaughan, electrical engineer, Bristol.—March 24th has been fixed for the hearing of application for discharge, at the Guildhall, Bristol.

Foreign Orders.—Among the orders received by Messrs. Jens Orten-Böving & Co. this year are the following for abroad:—

Chicugo, Japan.—One Francis turbine of 550 B.H.P.

Akaroa, New Zealand.—One Pelton wheel, working under a net head of 235 ft. and developing 50 B.H.P.; governor for same.

Nipissing Mining Co.—One turbo-pump to develop 4,800 U.S.A. G.P.M. against a head of 415 ft. This pump will be used in connection with hydraulic work proceeding in the mines of the Nipissing Co., in Canada.

Messrs. Mitsui & Co., Japan.—One water turbine governor.

Government Agricultural Engineer, Bombay.—One pump, to deliver 1,900 G.P.M., against a head of 31 ft.; and one to deliver 1,240 G.P.M. against a head of 44 ft.

Ontario Power Co.—Two patent Boving-Johnson valves of 48 in. diameter.

Trade Announcements.—We are informed that Rud. Chillingworth, of Nurnberg, has made arrangements for the sale of the Chillingworth Patent Pressed Steel Gear Cases in the United Kingdom, and for export therefrom, to be handled by the British Thomson-Houston Co., Ltd., exclusively. All inquiries hitherto sent to Rud. Chillingworth, at Nurnberg, or to his representatives in the United Kingdom, should in future be referred to the B.T.-H. Co., Ltd., Rugby, or to their branch offices.

The Electric and Ordnance Accessories Co., Ltd., state that the expansion of their business in Lancashire and Yorkshire has necessitated the doubling of their office accommodation at 196, Deansgate, Manchester, and the office has been moved from the first to the fourth floor.

The British Engineering Industries Co., 24, Linthorpe Road, Middlesbrough, notify that they have given up business, and that the firm has ceased to exist. Mr. J. D. Chisholm is open to accept an appointment.

LIGHTING and POWER NOTES.

Aberdeen.—An experiment which may ultimately lead to the revolutionising of the lighting system in streets traversed by the tramway route has been carried out in Albyn Place. Thirteen metal-filament lamps have been erected, the lamps being suspended from the cross wires which support the overhead tramway wires and stationed at alternate standards on either side of the street. It is intended to try the new lights for a month, and it will depend upon the satisfaction which they give whether any recommendation for their adoption will be made to the T.C. The 13 lamps are spread over an area which is at present lighted by 23 incandescent gas lamps. The candle power of the gas lamps is approximately about 40 C.P., but the lamps experimented with were three of 400 C.P., two of 200 C.P. and two of 100 C.P., while the others are of 150 C.P., the object being to give an idea of the effects of the different grades. Other experiments will be made.

At a meeting of the Corporation Electricity Committee, a deputation from the Great North of Scotland Railway Co. was received in connection with the supply of electricity to the company. An agreement was entered into for a period of five years. The Committee also came to an agreement for the supply of current to the new market buildings. It was reported that during the past month there was an increase of 52,870 in the units generated.

Afghanistan.—The Amir of Afghanistan has given his sanction to the scheme submitted by Messrs. F. and C. Osler, Ltd., for the establishment of a hydro-electric generating station to supply electrical energy for lighting and power purposes in Cabul. The plant will be located about 40 miles from the city, where the current will be generated at a pressure of 2,300 volts, this being transformed to and transmitted at 44,000 volts.

Ardrishaig.—A scheme for introduciug electric lighting is being considered, and the Brush Co. and the Gleniffer Electrical Co., Paisley, are inquiring into the matter.

Ashford (Kent).—The East Ashford R.D.C. has decided to withdraw opposition to the Ashford and District E.L. Co.'s application for a prov. order for E.L. on the company undertaking to lay cables as far as the workhouse at Willesborough, and as far as The Rose at Kennington, within two years.

Atherton (Lancs.).—A sub-committee of the Electricity Committee has been appointed to consider a report from the electrical engineer, recommending the provision of additional electrical plant. The engineer suggests that two 250-KW. transformers should be installed, together with some new feeders.

Aylesbury.—A prov. order for the E.L. is to be applied for by the Aylesbury E.L. and Power Co.

Bexhill.—The Council has decided that current for illuminations in connection with Coronation festivities shall be charged at the special rate of 2½d. per hour for each 20 8-C.P. lamp in use. The coal bunker at the electricity works is to be extended so as to provide accommodation for an additional 100 tons of coal.

Bexley.—The U.D.C. has instructed the manager of the electricity works to prepare a new assisted wiring scheme, which is to be reported upon by the E.L. and Traction Committee.

Bolton.—The Electricity Committee of the T.C. has decided to supply current for Coronation illuminations, at a discount of 50 per cent. from the usual price.

Bradford.—The entrance to the Kirkgate Market Hall is to be further lighted with 10 new electric arc lights of the latest type.

Burnley.—The Electricity Committee of the Corporation has had under consideration the provision of additional generating plant at the works. The cost of a 1,000-KW. turbine was estimated to be £1,400 less than that of a reciprocating set of similar capacity, apart from the saving in foundations and cranes which would be effected by installing a turbine set. Mr. Starkie recommended a turbine set with tandem generators instead of one, as it would be possible to run one generator on lighting and another on traction. The Committee decided to lay down a 1,200-KW. turbine plant with tandem generators, and a motor booster for lighting purposes, at an estimated cost of £8,129.

The Electricity Department anticipates a larger profit than estimated for the year ending March 31st next, and has increased its contribution to the rates from £4,000 to £4,500.

Canada.—The Ottawa municipal plant has had such a good year that it is about to reduce the cost for electric lighting from 8 cents per unit to about 6½ cents. The net profit for the year was $25,000. It has been decided by the management to reduce this profit for the coming year by some $18,000, thus giving the citizens the benefit of the profits. A charge of 4 cents per 100 sq. ft. of floor space and 3½ cents per unit is to be made in future, and this is figured to cost about 6½ cents per unit on the average, which is said to be the cheapest rate in Canada. Ottawa has probably the cheapest electric power of any town in Canada. Indeed, the Ottawa rate of $15 per H.P. per year is probably the cheapest power rate known anywhere.

Continental Note.—Spain.—The municipal authorities of Anguila (Province of Guadalajara) have recently invited tenders for the concession for the electric lighting of the town during a period of four years.

Croydon.—The B.C. decided on Monday that electric current supplied for Coronation illuminations shall be charged for at the rate of 1d. per unit, plus 5s. to existing consumers, for work incurred by the extra lighting; also a proportional increased cost to those requiring special services laid on, but not taking a permanent supply.

Dublin.—The Electricity Supply Committee has submitted a letter to the Corporation giving particulars of the progress of the electricity undertaking, in special reference to report No. 15 of 1911, which will come before the Corporation at its special meeting this week. The Committee considers that the financial progress of the undertaking during the nine months, December 31st, 1910, is much more satisfactory than even it anticipated. The city treasurer, in a letter to the Committee, states that if the available capacity of the plant at the Pigeon House is 4,500 KW., and the maximum demand in December last necessitated a capacity of 4,600 KW., it would be nothing short of criminal neglect if the Committee did not proceed to apply for such loans as would enable it to fulfil its obligations to the present consumers, and at the same time place it in a position to provide for the substantial additional demand which it is quite evident can be counted on. Mr. Fred. J Allan submitted a report to the Committee as to how far the additional capital is calculated to be reproductive. Having dealt in detail with the figures for the present financial year, he states that a deficiency of £4,000 has been turned into a current balance of £5,000. In view of the new requirements in the ensuing year in the South Dublin Union, the new College of Science, the Bolton Street Technical Schools, the G.P.O. extension, &c., Mr. Allan says that the increased profit should be over £6,000 better in the year ending March 31st, 1912, than in the current year. He sets down

the following estimate of net profits, after deducting the increased capital charges: Year ending March 31st, 1911, £5,000; 1912, £9,400; 1913, £12,500; 1914, £16,000; 1915, £20,000—£63,700.

Erith.—The U.D.C. has received from the L.G.B. sanction to loans of £5,025 for additional plant for the generating station, £1,850 for a Robison-Beltington water-tube boiler, £450 for mains, £1,350 for services, transformers and sub-stations, and £300 for motors for hiring out.

Fleinfoel.—Efforts are being made to have the parish lighted by electricity. The ratepayers favour the idea, and current is available from the Llanelly Traction and E.L. Co.

Golcar and Linthwaite.—The consent of the U.D.C.s to the use of overhead cables for the transmission of current in the district has been sought by the Huddersfield T.C.

Great Harwood.—An E.L. scheme has been submitted to the U.D.C. by Mr. J. W. Speight, who states that by it current can be supplied at less cost than gas. A committee of the Council is to confer with Mr. Speight.

Greenock.—The Secretary for Scotland has consented, in terms of the Electric Lighting Acts, to the borrowing by the Corporation of a further sum of £22,000 for the execution of capital works under the Greenock Electric Lighting Order, 1883, as amended, raising the total sum authorised to be borrowed for that purpose to £207,000. One of the conditions is that a sum of not less than £1,500 shall be annually set aside to reserve from the revenue of the electricity undertaking.

Hartlepool.—The proposal of the West Hartlepool T.C. to borrow £31,100 for the extension of their electricity undertaking by erecting a new generating station at Seaton Carew Iron Works and utilising the waste heat from the furnaces there, evoked strong opposition at the L.G.B. inquiry on Saturday. The scheme provides that the ironworks should have a supply of current free up to a fixed quantity. It was stated that the Corporation, if it utilised the waste heat, would be enabled to generate electricity at an extremely low cost. Mr. Lloyd, counsel for the Corporation, stated that the Cleveland and Durham Power Co. were also anxious to secure permission to secure the Seaton Carew Co.'s waste heat. The Corporation had approached the Power Co. with a view to obtaining a supply of current in bulk, but the acceptance of the offers made by the company would have meant the ultimate wrecking of the Corporation's undertaking. Alderman McFarlane denied that the Corporation's scheme was an absolutely novel experiment. Other corporations used waste heat. The inquiry was adjourned *sine die*.

Haslingden.—The town clerk read a letter from the L.G.B. on February 27th, regarding an application of the Corporation for sanction to borrow £5,000 for purposes of electric lighting. Mr. Watson reported his estimate for providing and laying a cable, &c., from the borough boundary at Baxenden to the sub-station at Prinny Hill, amounting to £3,750. This was approved, and application will be made to the L.G.B. for sanction to borrow this amount. It was now explained that a little difficulty had occurred between Haslingden Electricity Committee and Accrington Corporation, and if it were not got over the scheme would not go through.

High Wycombe.—The T.C. has resolved to enter into a seven years' agreement with the E.L. Co. for public lighting.

India.—The Chief Inspector of Mines in India, in his last report, states that electricity has been introduced into 13 groups of coal mines.

Leeds.—The City Council is to supply current for special illumination devices in connection with the Coronation festivities at a fixed charge of 7s. 6d. to cover the cost of inspecting and connecting the installation. This charge will include the supply of current for a period of one week.

Liverpool.—In the estimates of the Corporation for 1911 provision is made for commencing an improvement at the Lister Drive (No. 1) power station. Each side of the engine room contains six sets of plant each of 700-KW. capacity. It is proposed to replace four sets of the plant on one side by two turbo-alternators, each from 2,500 to 3,000 KW., and to correspondingly increase the condensing arrangements. It is also intended to put down motor-generators to enable the D.C. supply for the auxiliary plant for No. 2 station to be worked from the turbo-alternators. No new turbines will be required for some 18 months, and the sets of vertical engines which it is proposed to retain will serve as the "stand-by" provisions. The second side would also be similarly treated in course of time. Pumpfields station will subsequently be dealt with on similar lines, but for the present it is intended to restrict the working hours at this station as far as practicable by assisting the distribution from it by a supply of current from the Highfield Street motor-generators. The consulting electrical engineer is of opinion that the increased output from Lister Drive and Pumpfields will not suffice to meet the probable growth of business for more than two or three years, and that an additional generating station, of 40,000-KW. capacity, will before long be found necessary.

Mr. A. B. Holmes, consulting electrical engineer, in his report upon the electric supply department of the Liverpool Corporation, states that the supply of power from the Corporation mains is already equal to about one-eighth part of the total power used in the city, and the demand is steadily increasing. In the experimental "rateable value" system at present in operation, the electrical energy as metered, is charged at 1d. per unit, and the fixed charge per annum is 12 per cent. on the rateable value, or about 2s. 5d. in the £. An increase in the charge for electricity supplies for lighting private houses would appear to be justifiable, but as the use of radiators is extending, and a demand for cooking and other domestic services is commencing, it would probably not be worse, from a business point of view, to raise the price at the present moment. The advent of the metallic-filament lamp has checked the normal increase in the demand for energy, and consequently the plant provided to meet the usual rate of increase for the past two years has been in excess of the immediate requirements. This temporary check has, he thinks, now almost come to an end, and the normal annnal increase may be anticipated. Consumers, instead of cutting down bills, are now adopting a policy of getting more light for the same money.

In the annual report of the superintendent of street lighting of Liverpool, it is stated that, during 1910, the total length of roads electrically illuminated had increased from 5½ to 6¾ miles. The extensions were along Hardman Street, Myrtle Street, Catherine Street and Prince's Road. The report continues: "Fifteen lamps of the new flame arc type and 14 fitted with clusters of eight metallic-filament lamps have been fixed, thus effecting a great improvement in the lighting of these thoroughfares." In addition, Menlove Avenue has been lighted with 87 metallic-filament lamps.

The Electric Power Committee has recommended the T.C. to apply to the L.G.B. for a loan of £25,000 for electricity purposes.

London.—Hampstead.—A showroom is to be opened in Finchley Road for the exhibition of electrical heating and cooking stoves.

St. Pancras. — The Electricity Committee has had under consideration a communication from the electrical engineer with regard to a breakdown in the mains which occurred at noon on December 3rd in the Northern District. He recommends expenditure as follows:—One 1,000-KW. balancing motor-generator, including foundations, £2,400; additions to centre conductors, £3,000; one booster set, including all additions to switchboard, £500; total, £5,900. The Committee adds that it approved of the proposal to install at the King's Road Station a more powerful balancing set, as advised in the engineer's report, and the Finance Committee has passed an estimate for £2,400. The electrical engineer has further reported upon the failure of December 3rd, pointing out (1) that the earthing of the centre wire had the immediate effect of doubling the number of "faults." There were 12 "faults" in 1906, 24 in 1907, and 1 in 1908, but they increased to 54 in 1909 and 50 in 1910; (2) with the modern cables laid during and since 1895 only 8 "faults" have occurred over the five years, whereas with the cables previously laid 115 "faults" occurred during the same period, although the mileage laid with modern cable is 12 times greater. The electrical engineer has been in communication with the cable-makers asking for their quotation for stripping and reinsulating the entire length of this early cable. In reply, they ask him to forward them 200 or 300 yards of the cable to strip and recover, and he advises that he should be allowed to do this up to an expenditure of £400. He states with respect to this cable that no great deterioration has occurred during its 18 years' service, but that circumstances have changed whereby (1) the number of joints have enormously increased, and it is at the joint where the weak part always exists; (2) a very large power supply has developed; and (3) the arc lighting has considerably extended, and hence there is a continuous demand on the mains which did not exist 18 years ago. Having regard to the probable heavy cost which would be involved in carrying out the improvement of the whole of this cable at one time, the suggestion to send some 200 or 300 yards to the makers as a first instalment, at a limited expenditure, was the course which commended itself to the Committee for adoption. The electrical engineer further informed the Committee of an explosion which occurred in a culvert at the south-east end of Park Street on January 17th. As questions arose as to the condition of the mains in the neighbourhood, the electrical engineer reported thereon that the use of a copper strip in Park Street, having regard to the very heavy motor traffic for the past few years, is attended with greater risk than during the earlier parts of the undertaking. There is always a possibility of the insulators breaking through the jarring of the heavy traffic, and to this is attributed a breaking of an insulator about three weeks ago. There is a total section of cable capable of dealing with 1,200 amperes between the Oval Road and Regent's Park Road, while the actual load is 300 amperes. Altogether the mains in the district are of very ample capacity. It has been suggested that the variation in pressure is considerable, and the engineer was willing to admit a variation of five to eight volts, but this is within the Board of Trade limits, and having regard to the great distance the distribution extends from the generating station, in spite of the mains being of full capacity, it is almost impossible, without excessive capital expenditure on a long feeding main, to guarantee a narrower regulation of the pressure. He has made further inquiries as to linking up the network in the north and central districts, and finds that when the trouble on the mains occurred, these districts were completely coupled together, but the southern is kept separate from the central district.

Holborn.—At the meeting of the B.C. on February 22nd, the Works and General Purposes Sub-Committee reported having met on February 16th and settled a scheme of improved lighting for all the streets in the borough. It is of opinion that it is advisable that fresh tenders should be invited upon the basis of the actual requirements of the Council, and according to a specification which should be settled by the Works and General Purposes Committee.

The previous tenders were made according to a scale of prices for individual units of lighting; and although this is necessary for the purpose of any subsequent alterations that may be made, the Sub-Committee thinks it is essential that tenders should be also obtained quoting an inclusive price per annum for carrying out the scheme, so as to avoid the misunderstanding caused by calculations being based upon hypothetical figures. At present all the streets in the borough, except Kingsway and places where trial lamps have been erected, are lighted by upright incandescent gas mantles, giving on the average about 60 C.P. each, additional light being obtained at important points by grouping several of such units. The total candle-power of all lamps in the borough is about 140,000. The Sub-Committee proposes that the minimum candle-power should be increased to 90. The only case where new standards would be required is High Holborn and New Oxford Street, and here it was proposed that 48 new standards should take the place of the 101 old ones. The present high-pressure lamps in Kingsway give 900 C.P. each, and it is proposed to increase this to 1,800, which is desirable on account of the width of the road, and in order to correspond with lamps of that power erected in the Westminster portion of the thoroughfare. According to a schedule appended to the report, there would be 48 columns in High Holborn and New Oxford Street, of 1,500 C.P. each; in Kingsway, High Holborn crossing and Southampton Row there would be 28 columns, of 1,800 C.P. each; in Tottenham Court Road there would be 20 columns of 600 C.P. each. The lesser C.P. lamps would be divided as follows: 309 of 400 C.P.; 48 of 300 C.P.; 37 of 180 C.P.; and 1,390 of 90 C.P. The total number of columns would therefore be 1,880, and the total C.P. 404,160. In conclusion, the Sub-Committee recommended that the schedule be approved, and that the Works and General Purposes Committee be authorised to obtain and submit tenders for carrying out the scheme, either by gas or electricity on a specification approved by it for a contract of five years, to be extended to ten years at the Council's option. After some discussion as to procedure, the Council decided that it was out of order to receive the report until it had been considered and brought forward by the full Committee.

CHELSEA.—The question of the recent contract for street lighting by gas came before the B.C. last week, on receipt of a letter from the Chelsea Electricity Co. This letter, which disclosed the gas partisanship of the Council, has received a wide circulation and incidentally drawn rather more attention to municipal methods in Chelsea than the local councillors care about. A Mr. Hodgson attempted to hush matters up by moving immediately that the letter be not received, but several of the Council's apologists succeeded in speaking before the motion was carried. To Mr. Pickworth we turn for facts. He said he agreed with Mr. Hodgson that the Council had determined to vote for gas, and he concurred, mainly on account of the inconvenience of laying cables. The question of cost was never adequately discussed by the Council; it was "talked over" in committee, and finally "rushed through" in a hurried meeting. One member had pleaded for an adjournment to go into figures, but he was evidently squashed by his gas-at-all-cost colleagues. Mr. Pickworth evidently considered that the Council might have saved its reputation for fairness if the adjournment had been agreed to. We, and many others, think so too.

Loughborough.—A report has been presented to the T.C. respecting the proposed conversion from gas to electricity of 155 public lamps. The lamps at present cost £249 18s. 5d. per annum, and by the use of electricity there would be a saving of £86 10s. 6d. a year. The Highway Committee favours the conversion.

St. Helens.—Consequent upon the great increase in the demand for electrical energy, particularly for industrial power purposes, the Corporation is going in for a big extension scheme, to cost about £10,000. The proposals of the Electricity Committee, in conjunction with Mr. E. M. Hollingsworth, the borough electrical engineer, include extensions to buildings and plant, the latter comprising a 1,500-KW. turbo-alternator and condenser, for generating three-phase energy at 6,000 volts.

Salford.—Terms have been arranged with Messrs. C. S. Allott & Sons, for preparing preliminary plans and estimates of the cost of constructional work and alterations required in connection with the proposal to utilise the Walness Road depôt as an electricity generating station.

South Africa.—The Cape Town Corporation has been asked to submit a tender for the electric street lighting of the municipalities of Mowbray, Rondebosch, Claremont and Wynberg. Mowbray is at present under a contract with the Gas Co. for street lighting, and the other three municipalities have a street electric lighting supply from the Cape Peninsula Lighting Co., Claremont. It is believed that the contracts for street lighting of these municipalities all expire shortly. In addition to the street and private lighting of Cape Town, the Corporation now supplies the suburbs on either side of the town (Sea Point and Woodstock) as well as the whole of the Government requirements.

Southampton.—The Electricity Committee has reported that when the last L.G.B. inquiry in connection with loan sanctions was held, the Inspector expressed the opinion that it would be desirable in future to purchase all meters and lay services out of revenue account. At the time, the borough electrical engineer cordially endorsed the Inspector's views, and he recommended that, in future, this course be adopted. The engineer stated that he would even go further, and say that it would be as well if all small extension mains were charged to the same fund. The Committee decided that, in future, mains be charged to capital account, and that meters, services and small extensions be defrayed out of revenue. It further decided that application be made to the L.G.B. for sanction to borrow £2,700 for enlarging the trunk mains between the electric light station and Shirley and Portswood. Another application is to be made to the L.G.B. for sanction to borrow £3,000 for prospective mains.

South Shields.—The inquiry was resumed on February 24th into the application of the Corporation for sanction to borrow the sum of £9,410 for the purpose of providing extensions to its electricity plant. The inquiry was opened on October 5th last year, before Mr. E. A. Sandford Fawcett, when the application was opposed by the North-Eastern Railway Co. and Smiths' Dock Co. It was stated that the latter were considering the electrification of their docks, and were advised that direct current as supplied by the Corporation was unsuitable, and they required three-phase current. This three-phase current could be supplied by the Durham County Electric Power Supply Co., and the inquiry was adjourned in order that a conference might be held between the representatives of the Corporation and the Supply Co. These negotiations having failed, the inquiry was resumed before Mr. H. R. Hooper, with Mr. Honoratus Lloyd, K.C., and Mr. Fleetwood Pritchard for the Corporation, and Mr. E. F. Vesey Knox, K.C., opposing the application on behalf of the North-Eastern Railway Co. and Smiths' Dock Co.

Mr. J. Bridge, the borough accountant, said the net capital expenditure on the undertaking was £183,607, and they had unexpended borrowing powers for £14,635, and they were asking the Local Government Board to cancel borrowing powers for £7,343.

Mr. Lloyd sketched the history of the undertaking, which was commenced in 1896, and stated that in 1909 the demand for current had so increased that it became obvious that it was necessary to provide further plant in order to meet the demand. Some members of the Corporation at that time suggested the possibility of obtaining a supply from the Durham County Supply Co., but the Electricity Committee of the Corporation decided that the best plan in the interests of the borough was to extend the Corporation's existing plant. Eventually the Corporation adopted the recommendation of the Committee, and subsequently tenders were received, and some were provisionally accepted, subject to a loan being obtained. These tenders were for an engine and generator and cable, a total of £5,909. Mr. Lloyd explained that during the first 3½ years the undertaking was run at a loss, when the gross amount charged to the rates was £5,214, and in subsequent years a portion of the profits had been carried to the credit of the rates, amounting altogether to £3,514, so that the net amount charged to the rates from the beginning to the present time had been £1,700. The sinking fund had accumulated to £54,000, and there was a reserve fund of £9,800. He referred to the suggestion that the Corporation ought to take its current from the Durham County Supply Co., and pointed out that in that company's Bill passed in 1906, it was provided—for the protection of the Corporation—that neither the Durham County nor the Newcastle Supply Co. should supply electrical energy for any purposes whatever within, or for use within, the Borough of South Shields except to the North-Eastern Railway Co. and the Harton Coal Co. The North-Eastern Railway Co. had been desirous of obtaining power for the purpose of working parts of their system, and it was also represented by the Durham Supply Co. that the Harton Coal Co. were desirous of obtaining three-phase current for the working of their underground plant, and that it would be an advantage to the colliery to have such a supply, and the Corporation thought it was not fair nor desirable for it to object, so it conceded these points. But Sec. 27 of the Act, as passed, was inserted for its protection. As the outcome of the adjournment of the inquiry in October, three alternative proposals were submitted to the Corporation by the company. These proposals were referred to the Corporation's advisers who drew up a joint report which went before the Electricity Works Sub-Committee, which recommended the Corporation to act on the report of its advisers and refuse the company's offers. That recommendation was adopted by the Electricity Committee, and on January 4th last the T.C. adopted the recommendation and decided to proceed with the application to the L.G.B. to sanction the loan. The first of the company's proposals provided that a 21 years' agreement should be entered into. In the second proposal, terms were set out under which the company offered to supply current, but the Corporation would be able to show that it could supply electricity on better terms than the company could offer. The third proposal involved the leasing by the Corporation to the company of its generating station, and the company was to be free to install its plant in the Corporation's station, and the Corporation's engineer was to be responsible, subject to the instructions of the company. That involved the granting of a 21 years' lease. It also involved duality of control, and from a commercial standpoint, although for the first few years it would result in a saving to the ratepayers, it would be a mere temporary and slight advantage, which, in the course of a few years, would be turned the other way.

Mr. J. F. C. Snell, of Westminster, stated that after a very exhaustive analysis of the company's proposals, he had been obliged to advise the Corporation to definitely object to them. He thought it would be against the interests of the Corporation, as well as the ratepayers of the borough, should any of them be accepted. Speaking on the question of cost, Mr. Snell said that in 1913-14 the Corporation would, on a conservative estimate, reach a point beyond which its cost of production would be less than the price offered by the company.

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Mr. Vesey Knox said the plant belonging to the Corporation was absolutely useless so far as the company was concerned. The company had scrapped much more up-to-date and important generating stations than that owned by the Corporation.

Mr. Charles Merz, called to support the opposition to the application, said the question at issue was important from the point of view that the undertaking should be run at the maximum advantage financially, and that the district should have the best supply of power at the cheapest possible rate. The supply the company would offer the Corporation would give the latter a clear profit of £1,500 per annum, without responsibility, and without further capital expenditure.

Mr. Vesey Knox said it was a matter of common knowledge that electricity could be produced more cheaply on a large scale than on a small one. He contended that a station of the character of that owned by the Corporation could not produce the most favourable results.

After further statements the inquiry closed.

Stoke-on-Trent.—The scheme of the electrical engineer for unifying the Corporation's electricity undertakings, came before the T.C. at its meeting on Thursday last week. [We were able to give particulars of the proposed scheme—which is estimated to cost £60,000—in last week's ELECTRICAL REVIEW.] The Council was somewhat alarmed at the prospective outlay involved, the large increase in rates since the six towns of the Potteries have been federated being the subject of repeated complaints by the ratepayers. It was, however, emphasised that these extensions are absolutely essential, the works at Hanley, Burslem and Stoke being quite inadequate to cope with next winter's demands. The discussion was closured on the understanding that the Electricity Committee would further consider the matter, and bring the whole question before a special meeting of the Council.

The Electricity Committee received a further report from Mr. Yeaman at its meeting on Friday, when, after discussion, it was agreed to locate the new power station on a site adjoining the Hanley Works. By reason of its more central situation, this site will, it is understood, enable the Committee to effect a saving of from £4,000 to £5,000 in cable. The Committee will hold another meeting, in order to receive a more detailed report from the engineer before a special meeting of the Council is convened.

The T.C. has decided to supply energy to Messrs. Doulton's, Ltd., of Burslem, at £1 per KW. per quarter, demand charge, and ½d. per unit for current consumed. The same terms are to apply to large manufacturing premises in the Hanley area for current for motors.

Willesden.—The electrical engineer is to report upon the system of lighting at the Isolation Hospital; he reports that the establishment of the showrooms in High Road, Kilburn, has been productive of good results. The Electricity Committee has under consideration the expediency of supplying electrical contractors with electricity on special terms when their window show is of such a character as to advertise the Council's undertaking.

Worksop.—The U.D.C. has decided to provide a workshop, with lathes and machinery, at the electricity works at a cost of £300. A storage battery is also to be provided, and £200 a year for two years is to be set aside out of the income to meet the cost.

TRAMWAY and RAILWAY NOTES.

Belfast.—The financial success of the tramway undertaking, which is expected at the end of the year to contribute anything from £10,000 to £15,000 towards the relief of the rates, will raise several important questions for the consideration of the Corporation. The permanent way on several of the routes is badly in need of renewal, and the electric light consumers are demanding that the tramway undertaking should pay more for its electric supply than it has been doing, and so contribute something to the electricity department, and incidentally lighten the burden on electricity users.

Canada.—The annual meeting of the Ottawa Electric Railway Co. has been held. The report showed gross earnings for 1910, of $748,708, an increase of $71,351 over 1909. The net earnings were $277,229, an increase of $79,374. The number of passengers carried were 16,987,334.

Chile.—The *Diario Oficial* of December 31st contains a decree authorising the Chilian Electric Tramway and Light Co. to extend its Santiago tramway system as far as the communal district of Providencia. Twelve months are allowed for the completion of this work.—*Board of Trade Journal.*

Continental Notes.—GERMANY.—The draft of the contract proposed to be concluded between the Berlin City Council and the A.E.G., for the construction of an electric railway between Gesundbrunnen and Rixdorf, is on the point of coming before the Council for consideration. As contemplated by the scheme, a length of 3·72 miles would be built as an underground section, whilst the length of 1·86 mile in the north and south combined would be elevated sections. The concession is to be for a period of 90 years, and the railway is to be completed within five years from the date of the grant of State sanction. The contract provides for the maintenance of a service of trains at intervals of at least six minutes, and fixes the fares to be paid by passengers. A percentage of the gross receipts from passenger traffic is to be paid by the company to the City Council according to a pre-arranged scale, commencing at 2 per cent. on less than a yearly average of £50,000 per kilometre of line. The City Council is authorised to take over the railway during the currency of the concession, the first occasion being after the lapse of 30 years, and then at subsequent periods of five years. The City Council is to contribute towards the capital expenditure in constructing the railway by providing one-half of the money by the issue of bonds, the rate of interest on which is not to exceed 4 per cent.

SPAIN.—Les Tramways de Barcelone, Société Anonime have applied to the "Direccion General de Obras Publicas," Madrid, for powers to construct and work an electric tramway, called the Bordeta Electric Tramway, in Barcelona.—*Board of Trade Journal.*

Croydon.—It was reported to the B.C. on Monday, that the L.C.C. had written stating that the through booking arrangements between Croydon and London had entailed much additional work on the employés, while the advantages gained by the travelling public were not commensurate with the annual cost. It was therefore proposed that the issue of such tickets be suspended. However, a conference between the committees concerned was subsequently held. The result is that the through bookings between Victoria Embankment (*via* Westminster Bridge) and Victoria and Croydon are to be continued "for the present," but the through bookings between Victoria Embankment and Croydon, *via* Blackfriars Bridge, are to be discontinued, "except at such times as the L.C.C. may run direct cars from Blackfriars Bridge to Norbury" (the Croydon boundary).

Doncaster.—The T.C. proposes to extend the tramways to Brodsworth at an estimated cost of £3,000.

Edinburgh.—Proposals for the extension of the tramway system have been before a sub-Committee of the T.C. Among the letters submitted was one on behalf of a London electric construction company. Among the suggestions were new lines from the West End to Queensferry, Easter Road to Leith, West Port to Slateford, and Preston Street to Duddingston and Dalkeith. A petition was submitted from owners and occupiers of houses in Palmerston Place, and others, against the proposal to construct an electric tramway to Queensferry, starting from the south end of Palmerston Place, and also a letter from the Edinburgh South Side Merchants' Association, anent electric tramway extensions to the suburbs. The burgh engineer was asked to report on the various suggestions.

Halifax.—The littering of the streets with used tickets has claimed the attention of the Corporation Health Committee, who have directed the matter to the notice of the Tramways Committee with a request that it should endeavour to take steps to remedy the grievance. In the neighbouring city of Bradford the use of ticket boxes at each end of the cars is proving most successful, the result of their introduction having led not only to cleaner streets, but to cleaner cars as well.

Herts.—The C.C. has applied to the B. of T. for an extension of two years from August 21st next, for the construction of the Watford and Bushey Light Railway extensions.

Hull.—The Corporation Tramways Committee has decided to hand over £12,000 out of the current year's profits on the tramways to the relief of the rates. Last year £16,000 was taken from the profits. The residents in the Marfleet district are petitioning for an extension of the tramway system to Marfleet, which is on the eastern boundary of the city near the new joint dock. A petition in favour of the extension, signed by 682 persons, was presented, and the request was remitted to a Sub-Committee. On the motion of Mr. Ambler, it was resolved to have a report as to the service of motor-buses to Stone Ferry, upon which there had been an estimated loss of £4,944 on the year, which did not include road repairs or management expenses. It was thought that some other kind of service might be provided with better financial results.

Leeds.—The Guiseley District Council has decided to ask the City Corporation to extend its tramways from the present terminus at Oxford Road end to the White Cross Hotel.

Liverpool.—The Tramways Committee of the T.C. recommends the application to the B. of T. for a loan of £10,000 for new tramcars.

Manchester.—On Tuesday the Tramways Committee decided to send in an application to the B. of T. for the appointment of an arbitrator on the question of an eight-hour day for the tramway men. The points to be submitted for arbitration will be on the lines laid down by the Tramways Committee, as agreed upon by Mr. Jackson, secretary of the Amalgamated Association of Tramwaymen, and approved by the City Council.

Manchester—Altrincham.—Definite steps have now been taken with a view to the electrification of the Manchester, South Junction and Altrincham Railway. The line is under the control of the Great Central and London and North-Western Railways combined, and the prospective electrification has been considered by the boards of both companies. A quarter-hour service is spoken of, and it has been provisionally decided to build two new stations; one at the navigation crossings between Timperley and Altrincham which will be a great benefit to people living at Broadheath and to the residents of the Woodlands Park district of Timperley. It is stated that the second station will be between

Stretford and Sale. Large capital expenditure will be entailed by the scheme.

Morley.—On Friday last an inquiry was held in respect of the application by the Corporation for powers to construct a light railway in South Queen Street and Fountain Street. The section in South Queen Street was to take the place of one which was authorised by the Order of 1901 to be constructed at Town End, and the Fountain Street line was an additional section instead of the authorised construction of a line in High Street. The manager of the Leeds City Tramways (Mr. Hamilton) spoke as to the need for a variation of the Order, and stated that the cost of the proposed lines was estimated at about £10,000. The lines would be a continuation of the Leeds Tramways from the city boundary at Churwell, and it was intended that the work of construction should be placed in hand at once. No opposition was offered to the application, and the Light Railway Commissioners intimated that the application would be granted.

Walthamstow.—The Light Railways Committee reports having had under consideration the question of providing top covers on the Council's cars, and it has instructed the electrical engineer to bring up a report as to the cost of covering one car.

Wigan.—Application is to be made to the L.G.B. for sanction to borrow £2,600 for extensions of present loops and the construction of additional loops on the tramways.

TELEGRAPH and TELEPHONE NOTES.

American Telephone Merger.—According to a report in the *Times* "the plans for merging the independent telephone lines with the American Telephone and Telegraph Co. are progressing favourably."

Australia.—In a leading article the *Australian Mining Standard* complains bitterly of alleged overcharges on the toll telephone system, and declares that there is widespread discontent with the attitude of the Government on this subject. Doubtless, mistakes occur occasionally, but it is unreasonable to assume, as does our contemporary, that the public are "plundered in order to allow the authorities to dodge meeting their proper obligations." If the Australian public desire that their telephones shall be self-supporting, on an equitable basis, they must employ the measured rate; if, however, they prefer to subsidise the large users at the expense of the small ones, a flat rate will do as well as any other unjust tariff.

Hungary.—The Ungarische Telephonfabrik Gesellschaft is the name of a new company which has just been formed in Buda-Pesth with a capital of 1,500,000 crowns, to acquire and carry on the J. Berliner telephone works in that city.

Postal Telegraphs.—In last Friday's Parliamentary Papers Mr. T. Davies asks the Postmaster-General whether the testing duties in connection with the telegraph service have up to the present time been performed by the telegraph establishment; whether it is now proposed to place these duties under the control of the engineer-in-chief; whether this change is being recommended on the grounds of efficiency or economy; and whether, in view of the fact that these duties are being performed efficiently by a staff whose chances of promotion are already limited, he will take steps to prevent any further reduction in their prospects.

Mr. Herbert Samuel replies that the testing duties in connection with the telegraph service are still being performed by the telegraph establishment. The whole system of testing has recently been under consideration, but no decision has yet been arrived at on the subject.

Telephone Conference.—On Monday last, the conference convened by the Corporation of Glasgow was held in London; it was attended by representatives of some 80 boroughs in England and Wales, 18 Scottish boroughs, 17 Scottish county councils, and 36 urban district councils, besides several municipal associations. Resolutions were adopted urging that a Select Committee be appointed to consider and report on the whole question of the future control and working of the telephone system; that no increase be made in telephone charges until the said Committee reported; and that the present measured service rates were much too high, and were prejudicial to the use of the telephone by small traders and others.

Later, the Postmaster-General received a deputation which laid these resolutions before him. In his reply, Mr. Samuel said that in the telephone service efficiency was of prime importance; the telephone should be used as widely as possible—it was very insufficiently developed in this country, and he looked for an increase of three or four-fold; but the telephone service should not be asked to provide a large surplus revenue for the relief of taxation. The underaking should be conducted as a self-supporting business. He knew of no declared demand on the part of any municipality to undertake the telephone business, a field into which municipalities could not venture with advantage.

The highly technical business of telephony must essentially be supervised by highly-trained experts, whose services were costly. Of the six municipalities which had availed themselves of the Act of 1899, authorising them to undertake the telephone service, only two survived. There was no intention or possibility of revising the rates until they knew the cost of the transfer from the National Telephone Co. Many large users were getting their service below cost price, for many of the flat rates were unremunerative. The whole weight of telephone expert experience in England and America was against the flat rate for unlimited service. The Corporation of Glasgow gave a 5-guinea flat service, and paid half its operators 9s. a week or less—246 out of 302 received 12s. a week or less. After five years the undertaking had to be given up, on financial grounds; the plant was valued at £250,000 by the Post Office, which, however, paid £305,000 for it; the Corporation had to find £16,000 to make good its losses, and the Post Office spent £100,000 to provide a really adequate plant. The rates given were unremunerative, and brought the enterprise to the ground.

The measured service rates at present in force were higher than they would otherwise be, because a large number of users were supplied below cost price. When the transfer was completed and the cost ascertained, a scheme of rates would be formulated, and he had no objection to holding an inquiry into those proposals. The point would not arise for 18 months. He had no hesitation in giving them an undertaking that they should be afforded an opportunity of making their views heard.

On the same day a deputation from the Parliamentary Committee of the National Chamber of Trade waited on the P.M.G., and urged that there should be no change of rates until after the transfer, and that the subject should be investigated by a select committee. They thought that municipal control would best assist in bringing about cheap telephone rates. A similar reply to the above was given by the P.M.G.

Wireless Telegraphy.—A new system of wireless telegraphy and telephony, as reported a week ago, has been invented by Dr. R. Goldschmidt, of the Darmstadt Technical High School, which makes use of a specially constructed generator which produces the necessary electrical oscillations directly, and without sparks or arcs. This high-frequency machine delivers alternating currents whose direction is declared to change over 100,000 times per second, and as soon as the telegraph key is touched, the waves pass direct into the transmitting network. It is claimed that the system places no limit upon the distance over which messages can be sent, and that its working is independent of the daytime and the conditions of the weather. Tests with a generator of this type have been in progress since April of last year, at the radio-station of the C. Lorenz Co., at Eberswalde, near Berlin. The machine gives in the form of electric waves an output corresponding to about 17 H.P., and requires for this a generator of about 21 H.P., showing an efficiency of 80 per cent. According to the inventor, there is no difficulty in the way of constructing machines of 80 H.P., 100 H.P., or even greater power. On the other hand, it is declared that it was necessary until recently to use a 35-H.P. steam engine at the Nauen station, in order to produce wave energy of only from 2 H.P. to 3 H.P. The Lorenz Co., which recently gave a demonstration of the system before German Royalty, has acquired the patents for Germany, whilst the foreign patents belong to a company which was formed for the purpose some time ago.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberaman.—March 13th. Electrical goods, for the directors of the Powell Duffryn Steam Coal Co., Ltd., 101, Leadenhall Street, London, E.C., Stores Manager, Aberaman Offices, near Aberdare.

Aberdeen.—March 9th. One 1,000-KW. continuous-current turbo-generator, with surface condenser and air-pump, for the Corporation Electricity Department. See "Official Notices" February 24th.

Accrington.—Tramway storage battery, for the Corporation. See "Official Notices" to-day.

March 11th.—Tramway stores for the T.C., for a year; Tramway Offices.

Australia.—April 4th. 10¾ miles of lead-covered cable, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

April 18th.—One common-battery switchboard, for the P.M.G.'s Department in Western Australia. See "Official Notices" Dec. 23rd.

May 8th.—Battery of accumulators, with boosters and switchboards, for the Melbourne City Council. See "Official Notices" February 24th.

June 14th.—Switchboard, common-battery, multiple, for the P.M.G.'s Department in South Australia. See "Official Notices" February 3rd.

June 14th.—Branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

Barrow-in-Furness.—March 6th. Coal and stores, for the Corporation Electricity Department, for a year. Borough Electrical Engineer.

Beckenham.—March 20th. Meters, for the U.D.C. See "Official Notices" February 24th.

Belgium.—April 4th. The authorities of the Ecole de Pyrotechnie (Rempart de Hoboken), Antwerp, are inviting tenders for the installation of an electric lighting and power plant in the school.

Birmingham.—March 7th. Electrical stores for a year, for the Birmingham, Tame and Rea District Drainage Board; Mr. John D. Watson, Engineer, Drainage Board Offices, Tyburn, Birmingham.

Bolton.—March 6th. Materials and stores, for the Corporation Tramways Department. See "Official Notices" Feb. 24th.

Bootle.—March 4th. V.B. wires and cables, electric meters, arc lamp carbons, fuse boxes and terminals, arc lamp globes, compound and bitumen, incandescent lamps, &c., for the T.C., for a year; Borough Electrical Engineer's Office, Pine Grove.

Brighton.—March 6th. One 300-KW. three-phase induction motor-generator, for the Corporation power station, Southwick. See "Official Notices" February 24th.

Bristol.—March 7th. Arc lamp carbons, globes, joint and fuse boxes, and A.C. meters, for the Corporation Electricity Department. See "Official Notices" February 24th.

March 10th.—Unwashed small semi-anthracite or bituminous coal, for the Avonbank electricity works, for six or twelve months: H. Faraday Proctor, chief engineer, Electricity Department, Corn Street (returnable deposit, £2 2s.).

Burnley.—March 13th. The Guardians have decided to obtain tenders for electrical work for the ensuing year.

Croydon.—March 6th. Fuse and other boxes, meters, &c., lamp-posts and bracket arms, and feeder pillars, for the Borough Electricity Department. See "Official Notices" February 10th.

Dublin.—March 6th. 3,000-KW. turbo-alternator, condensing plant, boilers, stokers, steel chimney, pumps, piping, &c., for the Corporation. See "Official Notices" February 10th.

March 9th. Arc lamp carbons, for the Corporation Electricity Department. See "Official Notices" to-day.

Dundee.—The Electricity Department invites tenders for the supply of small coal, general stores and meters, for the insurance of boilers, and for the supply of oil. Mr. H. Richardson, City Electrical Engineer.

Eccles.—March 20th. One 500-K.V.A. steam engine, single-phase generator and exciter, for the Corporation. See "Official Notices" February 24th.

Edinburgh.—March 6th. Electric light installation for new Usher Hall, for the Corporation; Mr. J. A. Williamson, City Superintendent of Works, City Chambers, Edinburgh (returnable deposit of £2 2s.).

March 7th.—Two cooling towers, for the Dewar Place Corporation electricity supply station. See "Official Notices" February 17th.

March 7th.—Extension switchboard, for the Corporation. See "Official Notices" February 24th.

The Corporation invites tenders for electrical material for interior wiring, and jointing material for electricity supply cables. Electrical Engineer, Dewar Place.

Exeter.—March 8th. Clothing, for the Corporation tramway staff; Manager, Tramway Offices, Paris Street.

Hornsey.—March 6th. Meters, cables, troughing, &c., and distribution, joint and fuse boxes, for the T.C. See "Official Notices" February 17th.

Hyde.—March 4th. Vertical three-throw pump with electric motor, for the T.C.; Borough Surveyor.

India.—March 9th. Four electrically-driven centrifugal pumps, for the Cossipore station of the Calcutta Electric Supply Co., Ltd. See "Official Notices" February 17th.

Kendal.—March 14th. Underground feeder, for the Corporation Electricity Department. See "Official Notices" to-day.

London.—MARYLEBONE.—March 15th. (Amended notice.) Supplies, for a year, for the B.C. Electricity Department. See "Official Notices" February 24th.

HAMMERSMITH.—March 8th. Water-tube boilers, with superheaters, forced-draught furnace, mechanical stokers, economisers, &c., for the B.C. See "Official Notices" February 17th

L.C.C.—March 15th. Electrical installation at the Trade School for Girls, Belvedere Place, S.E. See "Official Notices" Feb. 24th.

March 21st.—Electric bellhangers' work, for three years, for the Commissioners of H.M. Works and Public Buildings. See "Official Notices" to-day.

Manchester.—February 27th. General stores for the Corporation Tramways Department. See "Official Notices" February 10th.

March 7th.—The Great Central Railway Co. are inviting tenders for electric light fittings and telegraph material.

Middleton.—March 8th. Barometric jet condenser, for the Corporation Electricity Department. See "Official Notices" February 24th.

March 7th.—Engine coal, for a year, for the Corporation electricity works. S. Pauls, Electricity Works.

Newport (Mon.).—March 7th. Electric light fittings, for the B. of G.; A. H. Rees, Clerk, Queen's Hill.

Norwich.—March 13th. Station battery, and motor-driven booster with regulating apparatus and switchboard, for the Electricity Committee. See "Official Notices" to-day.

Nottingham.—March 11th. Materials, for a year, for the Corporation Tramways Department; John Aldworth, general manager, Beastmarket Hill (returnable deposit of 5s.).

Partick.—March 6th. Materials, for a year, for the Burgh Electricity Department. See "Official Notices" Feb. 24th.

Pontypridd.—March 14th. Stores and materials for a year, for the U.D.C. Electric Lighting and Tramways Departments. See "Official Notices" to-day.

Reigate.—March 22nd. Two Diesel oil engines coupled to 100-KW. single-phase alternators, with exciters, &c., and main switchboard, for the T.C. See "Official Notices" to-day.

Rotherham.—March 23rd. One 1,000-KW. steam turbo-alternator, condensing plant, piping, H.T. switchboard gallery, switchgear, &c., for the Corporation Electricity Department. See "Official Notices" to-day.

South Shields.—March 8th. Stores, carbons, lamps, &c., for a year, for the Corporation electricity works; J. H. Cawthra, borough electrical engineer, Mill Dam.

Swindon.—March 15th. Stores, meters, oils, &c., for a year, for the Corporation Electricity and Tramways Department. See "Official Notices" to-day.

Twickenham.—March 8th. The U.D.C. invites tenders for the lighting by gas or electricity of the whole or portion of the public street lamps (not less than 200) for 12 months. Further particulars from the Surveyor, at the Town Hall.

Walsall.—March 7th. Purchase and removal of obsolete plant at the Corporation electricity works. See "Official Notices" February 24th.

Warrington.—March 14th. Electrical requisites, for six months, for the B.G.; A. Bottomley, clerk, Bewsey Chambers.

Wrexham.—March 17th. Supplies, for the T.C. Electricity Department. See "Official Notices" to-day.

York.—March 14th. 1,000-KW. turbo-generator and condensing plant, transformers and switchgear, water-tube boiler, feed pumps and pipework, for the Corporation. See "Official Notices" February 24th.

March 14th.—Tramway clothing, for a year, for the T.C. J. W. Hame, Tramway Manager.

CLOSED.

Australia.—The *Australian Mining Standard* publishes the following interesting information regarding the contract for the Victorian State Coal Mine electric plant, which, as already stated, has been ordered from the Australian General Electric Co., representing the British Thomson-Houston Co., Rugby, England, and the General Electric Co., of U.S.A.:—

Electric power-house equipment, £11,021; sub-station equipments, £5,155; travelling crane (35 ft.), £385; cables, poles, insulators, &c., £3,820; motors, controllers, pumps, winches, &c., £3,370; winding plant, £2,897; total, £26,648.

It has been stipulated that the following plant shall be made in Australia, and, if possible, in Victoria:—Transformers, generators, cables, £1,005; motors, winches, &c., £1,100; winding plant, £755; cables, poles, transmission line, £3,600; travelling crane, £400; total, £6,860.

The price of the travelling crane has been raised from £385 tendered to £400, in consideration of it being constructed in Australia. There is also a probability that a cooling tower, the supply of which is not included in the contract specifications, will be submitted later for tender, to be constructed in Australia at an estimated cost of £1,300. It will thus be seen that the Australian-made section of the work is likely to cost well over £8,000. Delivery of the whole plant at Wonthaggi is to be made before the end of the present year.

There were 15 unsuccessful tenderers, but only three of these tendered for the whole of the contract, the other 12 merely quoting

for sections. The shop tools (Section F) will be let out to one of the unsuccessful tenderers, but it has not been decided so far what firm is to get that work.

The unsuccessful tenderers for the whole of the plant quoted as follows :—

Messrs. Noyes Bros., £32,086.

Messrs. G. Weymouth Propty, Ltd. (engines to be locally manufactured in Castlemaine by Thompson & Co.), £53,695.

Messrs. Pfaff, Pinschof & Co. quoted for supplying the Charlotte Plains second-hand plant, £33,992. This plant is of considerably less capacity than the one which is to be installed, being of 1,200-KW. power, as against 1,500 KW., as called for in the tender, and as quoted by the Australian General Electric Co. and the other tenderers.

Two high-speed Browett-Lindley engines have been ordered by the successful tenderers from Messrs. Browett-Lindley & Co., Ltd., Manchester ; and one low-pressure turbine from the British Thomson-Houston Co., Rugby.

The *Australian Mining Standard* also states that the tender of Messrs. Warburton, Frankl, Ltd., has been accepted by the Yarrawonga Shire Council for the carrying out of the electric lighting scheme for the town of Yarrawonga, the amount of the tender being £3,273. There will be 70 street lamps of various candle-power.

Barking.—The T.C. has accepted the following tenders :—

W. T. Henley & Co.—220 and 440 yards of three-core cable, £33 and £50 respectively.

Union Cable Co.—440 yards of twin cable, £27; three-core cable, 2s. 4d. per yard.

Belgium.—Eight concerns submitted tenders to the Société du Canal Maritime, of Brussels, for three electrically-operated cranes, the lowest being that of the Compagnie Internationale d'Electricité, of Liège.

Cape Town.—The contract for the electric light wiring of certain residences in the grounds of the Royal Observatory (including the house of the Astronomer-Royal) has been placed with Messrs. E. A. Shaw & Co. The work is under the supervision of the Admiralty Electrical Engineering Department, Simonstown.

Croydon.—Ten tenders were received for the supply of five new cars for the B.C. tramways, the following being accepted :—

Car bodies.—Brush Electrical Engineering Co., Ltd., £225 per car.
Trucks.—Do., £59 10s per car.
Electrical equipment.—British Westinghouse Co., Ltd., £239 per car.

Darlington.—The Education Committee has accepted the tender of Messrs. Cox-Walker, of Darlington, for the electric light installation at the new schools in Kendrew Street.

Fleetwood.—The U.D.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for a balancer-booster set, at £165.

Greenock.—Messrs. Redpath, Brown & Co., Glasgow, have secured the contract for the steelwork, and Mr. James Anderson, Baillieston, for the excavations and brickwork, in connection with the extension at the electricity works.

Inverell (New South Wales).—The D P. Battery Co.'s tender has been accepted for a storage battery with booster.

Japan and India.—Messrs. Escher Wyss & Co. have been awarded the contract for six double high-pressure water turbines, complete with oil-pressure governors and pressure regulators, each designed for 12,500 H.P. under a head of 1,100 ft. The two exciter turbines will be of 1,200 H.P. each. These turbines will be put down at the Kinugawa Power Station (Japan), which when completed will figure amongst the most important power plants ever built. The same firm have also secured the contract for three single Francis turbines of 1,000 H.P. each, and two exciter turbines, all on vertical shafts, which are to be installed at the Gokak Mills in India. This latter order equally comprises the delivery of four centrifugal pumps, all of the same firm's approved design.

Lancaster.—The Corporation has accepted the tender of Milnes, Voss & Co., Ltd., for supplying four top-deck covers, similar to those in use on Bolton cars, at £93 10s. each.

London.—L.C.C.—The following tenders were received for steam piping and fittings for the compressed-air services at the second section of the central car-repair depôt :—

Standard Engineering Co. .. .. (accepted)	£69
John Spencer, Ltd.	74
Buck & Hickman, Ltd.	76
J. Russell & Co , Ltd.	80
J. Russell & Sons, Ltd.	87
Mosers, Ltd.	90
Stewarts & Lloyds, Ltd. .. .. .. (incomplete)	57
Chief Officer's estimate	90

Luton.—The T.C. has accepted the tender of Messrs. T. Balmforth & Co., of Luton, for a coal bunker at the electricity works, at £120.

Plymouth.—The Tramways Committee of the T.C. has accepted the tender of the Lorain Steel Co., of London, for 50 tons of tramway rails, at £6 19s. 9d. per ton, and 5 tons of fishplates, at £8 10s. per ton.

Salford.—The T.C. has accepted the following tenders :—

Charles Chapman & Sons.—Supply and erection of pumping plant in connection with the water-cooling tower scheme, £695.
Cleworth & Robinson.—Fireproof room at electricity works, £85.
Tudor Accumulator Co., Ltd.—Removing 85 cells and re-erecting same, £42.

Southend-on-Sea.—The T.C. has accepted the tender of Messrs. E. & B. H. Davey, of Southend, for the erection of a new storage battery room at Chalkwell Park, at £1,695 ; that of the Brush Electrical Engineering Co., Ltd., for four new tramcar bodies, at £244 each ; and that of the Peckham Truck Co., of London, for altering and lengthening the trucks of four old cars, at £127.

Watford.—The B. of G. has accepted the tender of Mr. W. S. Wilson, of Watford, for the installation of the electric light at the Children's Homes.

Wimbledon.—The tender of Messrs. Strode & Co. has been accepted for the electric lighting and heating of the new St. Peter's Church.

West Ham.—The Works Committee of the Corporation has provisionally accepted the tender of the Post Office authorities to provide and maintain, under a 10 years' agreement, "Buzzer" fire-alarm circuits, at a total proposed rental per annum of £522. The present rentals are £246. The Post Office are providing 15 additional points. At the end of 10 years the total rentals will be reduced to £333.

FORTHCOMING EVENTS.

Royal Institution.—Saturday, March 4th. At 3 p.m. Lecture on "Radiant Energy and Matter," by Prof. Sir J. J. Thomson. (Lecture I.)
Friday, March 10th. At 9 p.m. Discourse on "Recent Advances in Turbines," by the Hon. C. A. Parsons.
Saturday, March 11th. At 3 p.m. Lecture on "Radiant Energy and Matter," by Prof. Sir J. J. Thomson. (Lecture II.)

Junior Institution of Engineers.—Saturday, March 4th. At 3 p.m. Visit to the London County Council's Greenwich generating station.

Institution of Engineers and Shipbuilders in Scotland.—Saturday, March 4th. At 7 p.m. At the Grosvenor Restaurant, Glasgow. Smoking concert.

Institution of Electrical Engineers (Newcastle Local Section).—Monday, March 6th. At 7.30 p.m. At the Armstrong College, Newcastle. Paper on "The Laying and Maintenance of Transmission Cables," by Mr. C. Vernier.

Royal Society of Arts.—Monday, March 6th. At 8 p.m. Cantor lecture on "Applications of Electric Heating," by Prof. J. A. Fleming. (Lecture I.)

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, March 7th. At 7.30 p.m. At the Municipal School of Technology, Manchester. Paper on "The Development of the Diesel Oil Engine," by Mr. W. R. Cooper.

Institution of Civil Engineers.—Tuesday, March 7th. At 8 p.m. Further discussion on paper on "Modern Railway Signalling," by Mr. A. T. Blackall.
Wednesday, March 8th.—Students' visit to the District Railway Widening Works, Turnham Green.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, March 8th. At 7.30 p.m. At the University, Birmingham. Paper on "The Non-Salient Pole Turbo-Alternator and its Characteristics, by Mr. S. P. Smith.

Association of Engineers-in-Charge.—Wednesday, March 8th. At 8 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Gas Producer Plant," by Mr. W. A. Tookey.

Institution of Electrical Engineers.—Thursday, March 9th. At 8 p.m. Paper on "The Laying and Maintenance of Transmission Cables," by Mr. C. Vernier.

Physical Society.—Friday, March 10th. At 8 p.m. At the Imperial College of Science. Papers on "Note on an Electrical Trevelyan Rocker," by Dr. W. H. Eccles; and "Notes on the Tilted Gold-leaf Electroscope," by Dr. G. W. C. Kaye.

South-Western Polytechnic Institute.—Friday, March 10th. At 8 p.m. Presentation of prizes and certificates by Sir A. Keogh, K.C.B.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

THE following orders are issued :—

Commanding Officer—COL. H. M. LEAF.

Monday, March 6th.—"A" Company. Technical drill, 7 to 10 p.m.
Tuesday, March 7th.—"B" Company. Technical drill, 7 to 10 p.m.
Thursday, March 9th.—"C" Company. Technical drill, 7 to 10 p.m.
Friday, March 10th.—"D" Company. Recruits' infantry drill, 6.30 to 7.15 p.m. Technical drill, 7.15 to 10 p.m.

(Signed) P. H. CAMPBELL, Capt. R.E., Adjutant.

Electric Steel in Mexico.—A contract has been made between the Mexican Government and a British subject for the establishment in the Republic of a factory for the electrical production of iron and steel. The concessionaire possesses large iron ore deposits of the value of at least over £100,000, and undertakes within two years to produce manufactured iron in his factory, by an electrical process, at the rate of not less than 1,200 tons per annum.

Legacy for Science.—M. Loutreuil, the son of a French peasant, who became a wealthy contractor in Russia, has left £284,000 for the promotion of science in France ; £100,000 goes to the University of Paris, £140,000 to the Académie des Sciences, £4,000 to the Pasteur Institute and £40,000 to a fund for scientific research.—The *Times*.

NOTES.

Parliamentary.—*Electrical Imports to British South Africa.*—Mr. Newman, on Tuesday, asked the Secretary for the Colonies whether his attention had been drawn to the report recently issued by the Controller of Customs to the British South Africa Co., in which he stated, amongst other things, that the imports of electrical machinery from Switzerland had largely increased, whilst imports in these articles from the United Kingdom had decreased. Mr. Harcourt, in reply, stated that it was not correct to state that the imports of electrical machinery from the United Kingdom to the company's territory had decreased at all in value.

North-Eastern Railway.—Mr. Herbert Craig asked the President of the Board of Trade whether his attention had been called to the type of passenger coach employed by the North-Eastern Railway Co. on their electric train service on the Tynemouth branch; whether he was aware that on these coaches, which were unattended by servants of the company, the only exit was by means of hinged doors opening inwards into a vestibule, which was frequently so crowded with standing passengers that the door could not be opened or easily reached by persons wishing to alight: and whether, in view of recent railway accidents at home and abroad, where many casualties had been caused through the inability of passengers to escape from wrecked carriages of a similar type, he would cause inquiry to be made by Board of Trade experts as to the suitability of rolling stock of this character for suburban passenger service. Mr. Buxton replied that he had communicated with the company on the subject of the question, and had received a reply, a copy of which he was forwarding to the hon. member.

Bristol Tramways.—On Wednesday, February 22nd, the Court of Referees, presided over by Mr. Alfred Emmott, sat to consider whether a number of authorities should be allowed to appear before Committee in opposition to the Bill promoted by the Bristol Tramways Co. The *locus standi* was disallowed. Mr. Lankester, K.C., then addressed the Court on behalf of the Gloucester County Council, who, he said, ought to be allowed to appear before the Committee and say that the tramways should not be constructed unless the company made road widenings in certain places. After a long deliberation in private, the Chairman said that their decision was arrived at by a majority, and it was that the *locus* should be allowed. A claim by the Urban District Council of Kingswood, and the Rural District Council of Warmley, was disallowed.

Arbitration Proceedings.—Mr. Delvin inquired whether the arbitration proceedings as to the terms on which the Cavehill tramways may be acquired by the Belfast Corporation was being conducted in private, to the indignation of the ratepayers, and whether the President of the Board of Trade would order the Press to be admitted. Mr. Buxton replied that the question whether arbitration proceedings of this character should be conducted in public or in private, was one that rested entirely with the Arbitrator, and he had no jurisdiction in the matter.

Appointment of Committee.—A Select Committee, consisting of Mr. Guinness (chairman), Mr. Haydn Jones, Sir Randolf Baker and Mr. Hugh Law, has been selected to consider the following Bills:—Southampton Corporation Tramways, Metropolitan District Railway, London Electric Railway, Bristol Tramways, Great Northern Railway, Central London Railway and Liverpool Overhead Railway.

Barracks Lighting.—Replying to a question by Captain Gilmour, Mr. Haldane states that new barracks are being built at Abbassia, Cairo, in which it is intended to install the electric light, and it may be found possible later to extend this light to the old barracks. Large sums are being expended on the improvement of lighting in barracks generally, but it is not possible to meet all requirements at once.

Metropolitan Electric Supply Co. (Acton District) Bill.—This Bill came before the House of Commons for second reading on Tuesday, and an amendment moved and seconded by Labour members that it be read "this day six months," was defeated by 96 votes to 81. The Bill accordingly passed its second reading. Among the arguments used against the Bill, were that the ratepayers would be robbed of an undertaking just as it was beginning to prosper, that the interests of consumers were not safeguarded, and that the price offered was ridiculously low.

Inquiries.—The makers of the "Terenelle" storage battery are asked for.

Post Office Engineering Department, London.—The eighth annual dinner was held at the Connaught Rooms, Kingsway, W.C., on February 14th, Major O'Meara, C.M.G., Engineer-in-Chief, presiding. After the loyal toasts had been duly honoured, the Postmaster-General, in proposing the toast of "The Engineering Department," said the Post Office had now the biggest electrical business in the country, and in the future no one could tell to what extent that branch of the Post Office might develop. He referred to the extending use of mechanical appliances such as conveyors, the success of the loaded telephone cable between England and France, which had enabled telephonic communication to be made between Paris and Glasgow, the inauguration of the new electrical power station at Blackfriars, the establishment of new standards of electrical illumination, and of a system of synchronisation of clocks, and to the preliminary work for the transfer of the National Telephone Co.'s business to the Department. Some of the wireless telegraph stations round the coast, he said, were to be moved to new sites, and provision made for better equipment. Some changes in the organisation of the engineering branch were under consideration, to assist the branch to adapt itself to the changed conditions of the work with which it had to deal. They had been able to accomplish a very welcome improvement in the status and remuneration of the first-class staff engineers.

The chairman, in his reply, expressed appreciation of the interest manifested by Mr. Samuel and Sir Matthew Nathan in the engineering department, and said it was the work of the engineer which made for the material progress of civilisation and promoted the social welfare of the people.

Mr. W. Slingo proposed the toast of "The Visitors," and Mr. Alexander Siemens (president of the Institution of Civil Engineers) in his reply, remarked that he began his professional career as a telegraph engineer, having been employed in 1868 in Persia on the Indo-European line. They were setting out the line and taking straight cuts everywhere. Between Caswin and Teheran there was a mountain with a peak, and they laid the line quite straight for that peak for 80 miles. Not long after the line had been laid someone came and said, "Who was the idiot who laid that line?" He said the fellow had put the line right in the middle of the road; why on earth could he not have put it at the side? The explanation was this: The high roads in Persia were rather vague; the caravans would go one way, and when that got rather muddy they would go a few feet either north or south. But the caravans soon found out that the line went straight for 80 miles, and that it was the shortest way; so they followed the poles, some one side and others the other, and that was how the poles got in the middle of the road. His first experience of cable laying was in '69, when they laid a cable in the Black Sea, also in connection with the Indo-European telegraph.

Mr. S. Z. de Ferranti (President of the Institution of Electrical Engineers) said that his first connection with the department was about 1887, when he attempted to dispute with the Post Office the monopoly of the earth, as the Post Office at that time claimed the sole right to use the earth. He wanted to connect one point in his high-pressure electric supply system to earth so as to make sure that the outers of the concentric cables should not be raised above their natural pressure; but this was a thing impossible according to the then existing regulations. Eventually it was discovered that quite the safest thing to do was to make connection at one point of the high-pressure system to earth, and that it did not matter to the proper working of all the delicate apparatus with which they had to deal. The London Electric Supply Corporation, of which he was then engineer, about 1889, bought the best cables they could to transmit the 10,000-volt current to London. Two concentric cables were laid, mostly along the South-Eastern Railway from London Bridge and Charing Cross. Both turned out faulty, and had to be run at 5,000 volts. One day one of those cables failed about 4 o'clock. It was getting dark, and in another hour and a half the lights would have had to be shut down in the West End, so he determined to take the earth into his service. As they had very good earth connections in London and at Deptford—about seven miles apart—he determined to run the supply that night upon a single conductor, bringing the current back through the earth. Next day the papers said an electrical storm had stopped all communication between ourselves and the Continent as far as Rome. When they came to talk about the cause, he knew what had happened, and the principal engineer of the Post Office knew. He was very penitent, but said it was the result of necessity, and would not occur again. He wished the public at large could appreciate more fully the working of the engineering department of the Post Office. This work wanted the very best of engineers and electricians, and the public must expect to pay for the high standard required. They could imagine that there would be in the future an immense mechanically-propelled traffic department which would take the mails rapidly all over the country. Some day, certainly, a part of their department might have a great fleet of aerial ships, perhaps travelling at 200 or 250 miles an hour, probably driven by gas turbines, and taking all the mails all over the country in a time which they would now consider as ridiculous for its shortness. It was certainly a great thing to belong to such a service.

Mr. Trezise proposed the health of "The Chairman," in cordial terms, and Major O'Meara replying, said he was proud to be the chief of the engineering department of the Post Office.

An excellent musical programme was performed during the evening.

The 1911 I.M.E.A. Meeting.—The preliminary programme for the sixteenth annual convention of the Municipal Electrical Association disposes of speculation as to the whereabouts of this year's meeting. The convention is to be held on June 27th-30th inclusive; the first and third days will be spent at Brighton, the evenings being given up to a reception by the Mayor and the annual dinner. The second day's itinerary includes a special train to Portsmouth, where the meeting will be held, while the last day, as usual, will be given up to the annual general meeting and election of officers and Council. Apparently there will be the usual visits to works in the afternoons, including one to H.M. Dockyard, Portsmouth. Special arrangements are being made for the ladies of the party, who can this year attend the annual dinner. Headquarters, Grand Hotel, Brighton.

Municipal Corruption at St. Petersburg.—According to Press dispatches from St. Petersburg, the offices of the Westinghouse Co. there have been raided by order of Senator Neidgardt, who is undertaking the cleansing of municipal life. The seizure of papers at other engineering offices has also been ordered. The municipal electric tramway scheme was the last important contract placed, and the examination of the books appears to have been ordered with a view to finding material whereon the prosecu-

tion of members and officials might be based in connection with corruption said to have been proceeding in respect of certain other departments of the city's business. It is said that already, as the result of the search, one official has been relieved of his office, and is to be prosecuted.

Institution and Lecture Notes.—Institution of Electrical Engineers (Students).—The seventh annual dinner was held at the Trocadero on February 18th, the chairman, Mr. E. W. Moss, presiding over a gathering of about 70 members and friends. After the loyal toast, the vice-chairman, Mr. A. J. Paterson, proposed the health of "The President and the Institution," expressing the Students' appreciation of Mr. Ferranti's presence, and of the comfortable accommodation made available for them in the new headquarters. Mr. Ferranti, in reply, said he regarded it not only as a pleasure, but as one of the most important duties of the President to attend their annual dinner. He felt that there was a tendency nowadays to set the standard of knowledge too high, and to teach men more than they could use, with the harmful result that the standard of ability to apply their information was lowered. Every effort should be made to utilise more fully the knowledge acquired, and they should be most earnest in everything that they took in hand.

Mr. W. H. Patchell proposed "The Students' Section," remarking that it numbered 1,450 student members, upon whom the future of the Institution depended. He urged them to acquire a knowledge of at least one foreign language, and to pay great attention to perfection of detail in their work; electrical apparatus ought to be so robust that it could safely be placed in the hands of the most unskilled users. The Chairman, in his reply, commented with satisfaction on the greatly improved attendances at the Students' meetings, largely due, he thought, to their being more at home in their new quarters. He again pressed for the printing of abstracts of the Students' papers, pointing to the example set by the Mechanical Engineers. The attendance at the Birmingham visit last year was regrettably small; this year, he hoped, a foreign tour would be arranged.

Mr. Hayter proposed "The Colleges," and Prof. S. P. Thompson, in his reply, said that it was the aim of the colleges to teach the students to use their knowledge to good purpose; one often picked up odd facts which at the time seemed insignificant, but later found them to be of the utmost importance, as the keys to great inventions. As examples, he cited the anomalous behaviour of the rare earths in the spectroscope, which led to the invention of the Welsbach mantle; the occasional tetravalency of oxygen; and the phenomenon of electrification observed in the preparation of chocolate bonbons. He concluded by propounding the staggering problem—which cost more per pound, plum cake or a dynamo (the solution to which, we suggest, depends upon the 'eating).

Mr. Betts, in proposing "The Guests," put forward a suggestion that the Section should make arrangements to co-operate with the Student Sections of other Institutions.—Major W. A. J. O'Meara, in reply, deplored the lack of engineers amongst the nation's administrators, and declared that if this country was to maintain its commercial supremacy, technical undertakings must be controlled by technical men. It was his opinion that the training of an engineer made him an administrator, and he urged his hearers to aspire to that position.

Mr. R. J. Gamnel, chairman of the London Students' Section of the Institution of Civil Engineers, also responded to the toast. The entertainment provided during the evening was of quite exceptional merit; in particular, Mr. Coverdale's songs, Mr. Hargreave's legerdemain and Mr. Joseph Bull's extremely clever banjo solos deserved high commendation.

Institution of Electrical Engineers (Manchester Section).—The annual dinner was held on February 24th. The Chairman of the Section (Mr. J. S. Peck) presided, and about 130 members and visitors were present. After the loyal toasts had been duly honoured, Sir T. T. Shann (Chairman, Manchester Education Committee) proposed "The Institution of Electrical Engineers." He regarded the Institution as one of the most important in the country, and was pleased to learn that a sub-committee had been appointed to consider the application of electricity in the textile industry, which would be of great advantage to Manchester and Lancashire generally. The Manchester local section had a membership of something like 800, and was one of the strongest and most progressive of the several branches of the Institution. Mr. S. Z. de Ferranti, the President, in responding, said he hoped that the Manchester Section, which was not only the first to come into existence, but the first in importance, would do a great deal more than had been done to see that the membership was increased and the standard of papers maintained. There were changes which (as the Institution grew) it would be necessary to make, and matters were now being considered with a view to improving the general working of the Institution all over the country. He thought the best way to do that, in the first place, was to make it thoroughly strong and united. He did not think the Institution could maintain its position by remaining a purely scientific body. No doubt that was all right up to a certain point, and was a safe course to follow; but he preferred that it should make mistakes, or at least take the risk of doing so, rather than that it should pursue the course of not doing anything on behalf of its members. The co-operation of every member of the Institution was required to do whatever was possible to make the Institution more useful. The very fact of the electrical interests warring against each other was not reasonable, and reduced the possibilities of profit to everybody. He was trying to emphasise the fact that there was one interest in electrical matters, and that was progress, development and practical application of electrical science, and everything that could be done towards bringing that about should be done. Mr. J. S. Peck, who also responded, said the local sections were the means of keeping members in touch with the profession and of bringing them together. The Council in London received suggestions from Local Sections with the most careful consideration. It was now proposed to hold a conference to discuss the question of promoting the best relationship between the Local Sections and the Institution, and he was sure the result would be a beneficial one. They had a long way to go to equal the papers which were read before other institutions in this and other countries. He did not think they would equal the standard of other countries until they had a prosperous industry behind them, till the manufacturers were in a position to be able to spend money in promoting large schemes and carrying on experimental work.

Mr. W. Cramp proposed "The Visitors," and Councillor Royse, J.P., in responding, said he had no doubt that the cotton mills, of which there were a large number within 20 to 30 miles of Manchester, would shortly be driven by electricity, and Manchester, under the able guidance of their chief engineer (Mr. S. L. Pearce), would do its utmost in that direction.

During the evening musical selections were given, to which Miss Phyliss Finch and Messrs. Cuthbert Allan, T. M. Kerby and Mr. B. Pochobradsky contributed.

Railway Signal and Telegraph Engineering Institute.—At a meeting held at the St. Marylebone Church Institute on February 20th, Mr. Moseley (L. & S.W. Railway) read a paper on "Mechanical Locking of Levers," illustrated by models and lantern slides. At a general business meeting, which followed, it was resolved that the movement be continued and that the rules be altered in several respects. Papers have been arranged for up to the end of the season, and visits are to be organised. Mr. G. E. Gurney, the secretary, writes stating that he has received inquiries from time to time as to how the formation of the new organisation, the "Institution of Signal Engineers," will affect the Institute. He states that the latter will be conducted on quite independent lines as a debating society in the interests of the two departments and the members who support it. The contribution has been reduced from 6s. to 5s. per annum, payable in advance, and any gentleman interested in this class of engineering off the railways is eligible. Mr. Gurney invites the assistance of any new supporters from among our readers.

Dundee Institute of Engineers.—Mr. H. Richardson, Corporation electrical engineer, delivered a lecture last Saturday on "Railway Electrification."

Institute of Marine Engineers.—On February 20th, a lecture was given by Mr. G. A. H. Binz on "Electrical Distance Thermometers." Mr. Binz said that a demand had arisen for a temperature indicator which would render possible a centralisation of all important temperature readings at one point. This was accomplished by the electrical thermometer. The parts of the apparatus sensitive to temperature were entirely of metal, strong, rigid and all but unbreakable. The resistance elements were composed of coils of very pure nickel wire, in the form of a closely-wound coil, enclosed in a tube of suitable length and provided with a couple of terminals. It was connected to the temperature indicator by means of ordinary copper wire. A 2-volt accumulator provided all the current required to work the whole system.

L.C.C. Tramways Engineering Society.—On the 8th ult. a paper was read by Mr. W. F. Kearsley on "Sub-Station Operation," with special reference to traction work. The author described in detail the equipment of a sub-station, and discussed the relative merits of motor-generators, motor-converters and rotary converters, preferring the last-named. Particulars were also given of the routine followed in starting and running each type of machine. A discussion followed the reading of the paper, Mr. Shepherd presiding.

Institution of Mechanical Engineers.—The annual report of the Council shows that the total membership at December 31st was 5,700, including 2,521 members, 2,419 associate members, and 693 graduates; the net increase was 117. The total revenue for the year was £15,625, and the expenditure £12,734, leaving a balance of £2,370, exclusive of entrance fees and life compositions. The total assets amounted to £92,302, and the net capital to £57,004. Plans are in hand for the extension of the Institution House.

Institution of Civil Engineers (Manchester Students).—On February 22nd a paper was read by Mr. R. G. Parrott on "Static Transformers."

Belfast Association of Engineers.—The annual social meeting of the Association was held on February 25th, and was largely attended. The report of the hon. sec., Mr. F. W. Parkes, showed that there had been a very large increase in the membership. At an ordinary meeting recently, Mr. T. Gibson read a paper on "The Diesel and Other Oil Engines."

Association of Engineers-in-Charge.—The sixteenth annual dinner of the Association will take place at the Holborn Restaurant on Saturday, March 25th. The president, Capt. H. Riall Sankey, R.E. (retired) will preside. Tickets can be obtained from the hon. secretary at St. Bride's Institute, E.C., to whom early application should be made.

On February 22nd, Prof. Gisbert Kapp lectured on electric railways to the members of the Birmingham and Midland Institute Scientific Society, at the Institute.

On February 20th Mr. H. Laws Webb read a paper on "State Telegraph and Telephone Monopoly," before the British Constitution Association—mainly a repetition of that which he read before the London Chamber of Commerce, and of which we published an abstract in our last issue. In the discussion Mr. Harold Cox, who presided, pointed out that the telegraphs had involved a capital loss of about 35 millions sterling, and a current loss of a million a year. He thought the suggestion of a telephone authority on the lines of

the Port of London Authority excellent; but it ought to apply to telegraphs as well. So long as they were subject to political control, these concerns would not be run on commercial lines. He suggested that a league of telephone users should be formed.

The Municipal Wiring Conference Suspended.—We have received with regret the following communication:—

"*Re* Conference between the representatives of the Incorporated Municipal Electrical Association and the Electrical Contractors' Association (Incorporated).

"I am instructed to inform you that after four meetings of the above Conference, it was finally decided that, owing to the impossibility of agreeing to the contentious matter discussed, that this Conference be suspended until further notice, and that each side be free to take any action they may think desirable, subject to the resolutions agreed upon.

"It was further resolved to recommend that a Standing Joint Committee of four on each side be appointed to try and adjust matters of dispute that might arise.

"Leonard G. Tate.

"London, E.C., *February 22nd*, 1911."

We had hoped that some definite agreement would have been arrived at as the result of these meetings. However, it is something to have it recorded that there should be a Standing Joint Committee to settle any disputes that may arise. As, in the case of another Conference, it would be extremely interesting to know on what question the proceedings have broken down, also what those resolutions are. If any information is vouchsafed us we shall return to the matter.

Colliery Electrification.—At the annual meeting of Messrs. James Dunlop & Co., Ltd., held in London last week, the chairman, Mr. Peter Donaldson, said that this year they proposed to spend a considerable amount of money on the electrification of their coal pits, and this would lead to considerable economy in working cost.

Appointment Vacant.—Principal and organiser for the Science and Technological Department of the Crawford Municipal Technical Institute, Cork (£400). See our advertisement pages in this issue.

Will.—The gross movable estate of the late Mr. J. T. Tullis, chairman of the Craigpark Electric Cable Co., Ltd., is estimated at £118,841, and the heritable estate at £54,848, making a total of £173,689.

Whitehaven Colliery Explosion.—In his report on the Whitehaven disaster, Mr. R. A. S. Redmayne, Chief Inspector of Mines, says that it is most desirable that men working in the neighbourhood of goaves consisting of hard rock which does not readily fall or bend, where a fall of roof is likely to be of great danger, should be provided with electric lamps instead of oil safety lamps.

Cost of Living in Persia.—A correspondent who has recently had occasion to collect information from official quarters here as to the conditions in Persia in comparison with those in England, has ascertained that the cost of living in Tabriz is considerably less than here, and an income of £150 per annum there would be approximately equivalent to £300 in England. Furthermore, the climate is very healthy, being mild in summer and very cold during the winter months. Lest there be too big a rush for Persia, let it be stated that whatever we save out of that princely £150 does not double its value when we return to England to spend it in retirement and content!

Receiver Appointed.—Mr. C. Cooper, 33, Princess Street, Manchester, has been appointed receiver and manager of Cowans, Ltd., on behalf of the first debenture-holders.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Chester T.C. has increased the salary of Mr. S. E. Britton, electrical engineer, from £500 to a maximum of £600 per annum, by £20 a year, on condition that he agrees to remain with the Council for five years. The salary of Mr. Percy Heard, station superintendent, has also been increased from £180 to £190.

Although still suffering from the effects of his recent accident, Mr. W. T. Le Feuvre, borough electrical engineer of Bexhill, has resumed his duties.

The Salaries Committee of the Bristol Council have decided in favour of the salary of Mr. H. Faraday Proctor being increased from £700 to £750 per annum, and by two annual increments of £25 to £800 per annum. In the Committee's report on the matter, it is mentioned that Mr. Faraday Proctor has received during the last eight years in respect of Improvers' Premiums on an average £103 per annum.

Mr. R. W. Hill, canvasser to the Heston and Isleworth Urban District Council, has been appointed canvasser to the Harrow Electric Light and Power Co., Ltd.

Tramway Officials.—The L.C.C. Highways Committee makes the following recommendations for annual revisions of salaries of the staff of the Tramway Department:—

Mr. J. Welling, permanent way engineer, to be increased from £550 to £575.
Mr. E. W. Dickinson, superintendent of the Greenwich generating station, to be increased from £450 to £475.
Mr. E. L. Pope, resident electrical superintendent, southern section, to be increased from £425 to £450.
Mr. T. L. Horn, resident electrical superintendent, northern section, to be increased from £375 to £400.
Mr. G. T. Dickins, stores superintendent, from £300 to £325.
Mr. J. Terry, district traffic superintendent, southern section, from £300 to £325.

The Halifax Tramways Committee recommends that the salary of Mr. J. D. Caird, traffic manager, be increased from £275 to £300 per annum. A resolution which had been carried by a Sub-Committee to advance the salary of Mr. J. W. Galloway, the tramways engineer, from £250 to £275 per annum, did not receive the approval of the full Committee, and it was not carried.

On February 23rd, at Motherwell, Mr. Atkinson, chief assistant engineer with the Lanarkshire Tramways Co., was entertained to dinner by a number of his friends on the occasion of his resigning to take up an appointment in the Argentine Republic. The staff of the company presented Mr. Atkinson with a pocket book and purse of sovereigns, the general manager, Mr. G. F. Moller, making the presentation.

Mr. L. Marshall Jockel, electrical engineer's department, Glasgow Corporation Tramways, has been appointed assistant engineer and under-manager to the Mexborough and Swinton Tramways Co., at Rawmarsh Tramway and Electricity Works.

General.—A presentation, consisting of two solid silver candelabra and a solid silver vase, was made to Mr. T. E. Ingoldby, B.A., A.M.I.C.E., for four years assistant works manager Messrs. Siemens, Stafford, on the occasion of his promotion to the company's head office in London. The presentation, which is exceptional in that it is the first time in the history of the works that an official has been so honoured, except on leaving the company's service, was made by Dr. M. Kloss, in the large hall of Siemens' Institute, Stafford, on Friday, 16th ult., in the presence of the members of the Siemens Literary and Debating Society, of which society Mr. Ingoldby had been president. The large gathering, which included the principal members of the Stafford staff, and the hearty applause which greeted the Doctor's able speech appreciative of Mr. Ingoldby's services to the company, showed how popular the assistant manager had made himself, and how much his leaving was felt. Mr. Ingoldby was also accorded a hearty vote of thanks for his services as president of the debating society.

An L.C.C. Committee has recommended that the salary of Mr. C. A. Baker, the principal electrical assistant in the chief engineer's department, who entered the service in September, 1906, at a salary of £500 a year, be advanced to £550, rising a year later to £600. The Committee report:—"The work which he supervises has grown considerably, and we are advised that he carries out his duties most efficiently, and that the responsible character of his work fully justifies his advancement."

It is also recommended that Mr. E. Ridley, electrical and mechanical engineer at the chief station of the L.C.C. Fire Brigade, be promoted to the position of principal assistant, his salary being advanced from £400 to £450, rising by annual increments of £25 to £500.

Among donations and gifts recently announced at meetings of the Institution of Electrical Engineers are donations of £200 to the Benevolent Fund from the executors of the late Mr. Gustav Byng, and £21 to the Building Fund from Sir David Salomons, Bart., who has also presented to the Museum of the Institution a complete electric balance by Prof. Hughes, a door contact and bell by Sir Charles Wheatstone, and a Hughes microphone model, probably the first ever made.

Mr. Buchanan, B.Sc., A.R.C.Sc., Whitworth Scholar, M.I.E.E., Senior Lecturer to Faraday House, London, has been appointed Professor of Electrotechnics at the School of Mines (Transvaal University), Johannesburg. The salary is £1,000 per annum, and Mr. Buchanan will be allowed to engage in consulting work.

Mr. W. Bolton Shaw, M.Sc., A.M.I.E.E., for a number of years electrical engineer to the Hulton Colliery Co., Ltd., and more recently connected with Messrs. John Musgrave & Sons, Ltd., as chief turbine designer, is now in practice as a consulting engineer, and has opened an office in Irene Chambers, 25, Market Street, Manchester, where he will undertake the laying out of colliery and other industrial installations, and advise on turbine schemes, and the application of electricity to mining and general power work.

Mr. T. H. Brett, late of the Leigh Corporation Electricity Department, has been appointed agent for the district by the Luna Metal Lamp Co.

Obituary.—Mr. Joseph McDermott.—We deeply regret to learn of the death of Mr. Joseph McDermott, J.P., managing director and chairman of the Lancashire Electrical Engineering Co., Ltd., of Ashton-under-Lyne, which occurred on February 23rd, at the age of 53 years. Both as a president of the Electrical Contractors' Association for a period of one year, and as representative of that Association in other capacities, the deceased gentleman had been unceasing in his efforts to protect and further the interests of electrical contractors. He will be remembered by many by reason of his connection with the Manchester Electrical Exhibition of 1908, on the committee of which he acted as one of the representatives of the contractors.

ELECTRIC WINDING AND HAULAGE PLANT.

The following particulars relate to some interesting winding and haulage gear supplied by Messrs. E. Scott & Mountain, Ltd., of Gateshead-on-Tyne, for the Linlithgow shale mines of Messrs. J. Ross & Co.

The first gear, which is driven by a 300-B.H.P. direct-current motor and is capable of working up to 500 H.P. for short periods, consists of two drums, each 7 ft. diameter by 2 ft. 6 in. wide, which run at a maximum speed of 49·5 R.P.M. The gear is built up on a massive cast-iron bedplate, consisting of three longitudinal girders and two lighter cross girders; the whole of the gearing and countershaft are carried between two of the longitudinal girders, a bearing being provided immediately on each side of the main gearing.

The motor is carried from the side of the gear, and is coupled to the pinion shaft through a flexible coupling in such a way that the motor can be withdrawn without disturbing the driving arrangement.

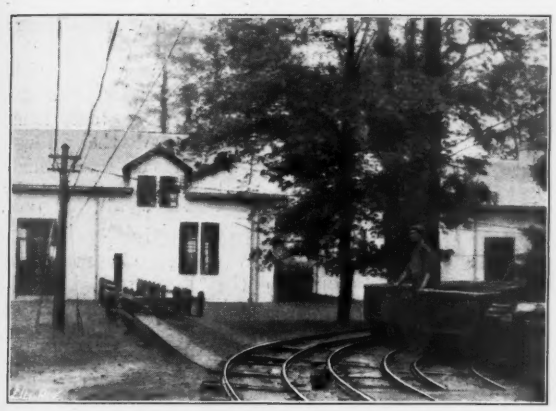


FIG. 2.—THE LARGE WINDING ENGINE HOUSE.

This winding gear is situated in the large engine house, together with an endless rope gear, and is shown in fig. 3.

The driver's platform for the large gear is shown on the right hand; the whole electrical control is carried out by means of one lever, this lever being "off" in the "central" position, while a forward movement operates the motor in one direction, and a backward movement in the reverse direction. The control is carried out by means of a liquid switch with the necessary reversing switches.

Special automatic overwinding gear is fitted, which is operated from the depth indicator, and which in case of overwinding trips the main circuit-breaker in the motor circuit and also releases a solenoid which trips a weight and operates the brakes.

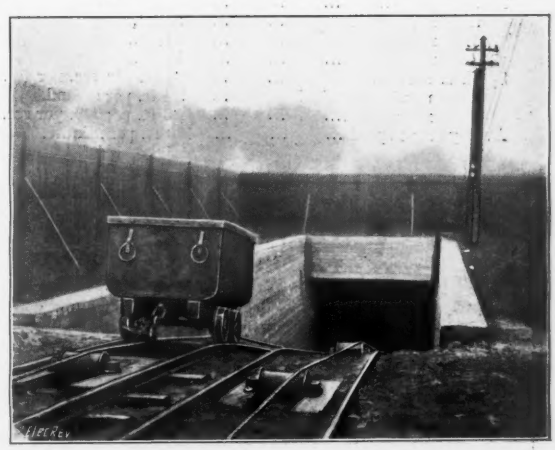


FIG. 1.—ENTRANCE TO THE DRIFT, SHOWING HAULAGE WAYS.

The following are the particulars of winding. The gear is used to draw tubs up an incline of 1 in 1¼:—

Depth of incline, vertical	773 ft.
Depth of shaft	960 ft.
Time of wind...	60 seconds
Acceleration	12 ,,
Maximum velocity	42 ,,
Retardation	6
Speed of acceleration ...	1·56 ft. per sec per sec.
Speed of maximum velocity	18·8 ft. per second
Retardation	3·12 ft. per sec. per sec.
Average rope speed	960 ft. per second.

The winding rope is 1¼ in. diameter, and the gross load hauled is 7 tons, the maximum unbalanced load being 3 tons.

The smaller gear, which is shown in fig. 4, is driven by 100 H.P. direct-current motor, and is capable of working up to 150 H.P.; it consists of one drum 5 ft. diameter × 2 ft. 6 in. wide.

Generally this gear is similar to the larger one; the gear wheels, as before, are of the double helical machine-cut type of cast-steel, and the control is carried out in a similar

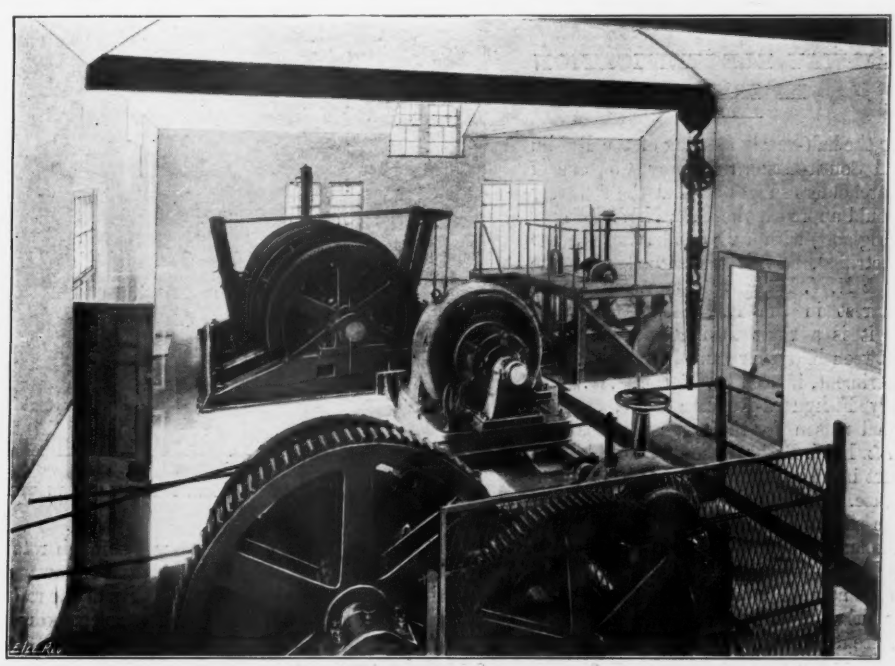


FIG. 3.—INTERIOR OF LARGE WINDING ENGINE HOUSE; ENDLESS HAULAGE IN FOREGROUND.

manner to the first-mentioned gear. The particulars of winding with this gear are as under :—

Gradient	1 in 1¼
Depth of gradient, vertical... ...	773 ft.
Length of gradiant	960 ft.
Time of wind...	120 seconds
,, acceleration	24 ,,
,, maximum velocity... ...	84 ,,
,, retardation	12 ,,
Speed of acceleration	·4 ft. per sec. per sec.
,, maximum velocity ...	9·4 ft. per second.
,, retardation...	·8 ft. per sec. per sec.
Average rope speed	480 ft. per minute.

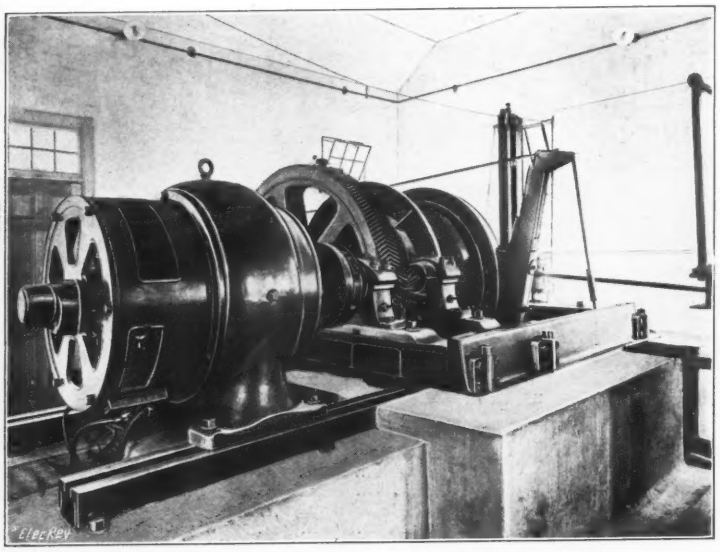


Fig. 4.—The 100-h.p. Winding Engine.

The winding rope is ⅞ in. diameter, the gross load is 2 tons, and the maximum unbalanced load 2 tons.

Power for operating these haulages is supplied from the firm's own generating station, in which are installed three Scott & Mountain three-crank compound high-speed engines coupled to direct-current generators of 350-kw. capacity each. A view of this plant is shown in fig. 5, and the remaining views, figs. 1 and 2, represent the large engine room and the entrance to the drift.

RAILWAY ELECTRIFICATION IN IRELAND.

At the half-yearly meeting of the Dublin and South-Eastern Railway Co., one of shareholders suggested that the company should approach the L. & N.W. Railway (England) with a view to having the line electrified. It is understood that the L. & N.W. Railway holds a considerable interest in the D. & S.E. Co., and, as it is anxious to increase the traffic between Kingstown and Holyhead, to the detriment, if need be, of the G.W. Railway Fishguard-Rosslare route, there is good reason for the suggestion that the L. & N.W. Railway should take a leading part in an improvement of radical importance. There could be no attempt upon the part of the D. & S.E. Railway to raise the large amount of capital which such an enterprise as the electrification would involve ; for that company has managed only now to squeeze a 1 per cent. sop into the droughty mouths of the holders of the ordinary stock, after an abstention from dividends for many years.

Now the D. & S.E. Railway, as a whole, cannot be considered a fit subject for electrification for a century or so, but that part of the system lying between Amiens Street (Dublin) and Kingstown is as good a railway property as any suburban line outside the London area, notwithstanding the severe competition of a parallel and practically "contagious" line of tramways. These tramways have catered so well for the long-distance passenger, by means of express (non-stopping) cars, that much traffic has been transferred from the railway to the tramway ; but improved rolling stock and better lighting have checked this drain somewhat. During the busy hours a 15-minute headway is maintained, express and slow trains alternating ; and, during the slacker hours, the stopping trains are lightened by the use of special carriages. This section of the line is double throughout, and the permanent way is fairly heavy and sound.

Probably the train service has reached very nearly its economical limit under existing conditions, but there are good precedent experiences which lead an engineer to suppose that this limit might be raised considerably if the section were worked by electric trains similar to those on the Liverpool Overhead Railway or the North-Eastern Railway.

This short section would yield bountifully to the stimulus of a five minutes' headway during four hours of the day, because all the through traffic, and much of the intermediate traffic, which have been allured by the tramways, would return to their old allegiance directly it became apparent that the time occupied by walking to the local station would be overbalanced by the train making the journey so much quicker than the tram.

The tramway power station is placed conveniently near the railway, although somewhat too close to one end ; and, leaving out of consideration the thorny questions of municipal objections and mutual rivalry, there is no scheme more economical of capital and of power than that of supplying 550/600-volt d.c. energy direct from the main tramway power station, and through rotary converters from the Blackrock and Kingstown tramway sub-stations, directly into the the third rail feeders of the railway.

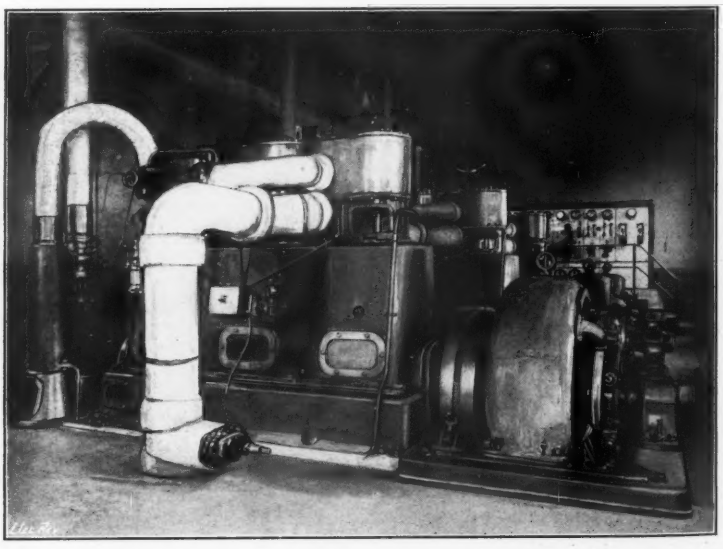


Fig. 5.—Scott & Mountain Plant in the Power House.

The cost of supplementary plant and mains would be trivial in comparison with the cost of a separate power station, sub-stations and mains, even if a suitable site could be found for the power station. But this note has no con-

cern with details, which we are content to leave to the L. & N.-W.R., when they come to tackle the question in earnest.

Judging from the newspaper report of the D. & S.E. meeting, our brave shareholder's suggestion did not draw any reply from the chairman, but he may live to see more importance attached to it.

So far as a casual onlooker can see, there is more than a sporting chance that electrification would keep the mouths of the shareholders moistened perpetually.

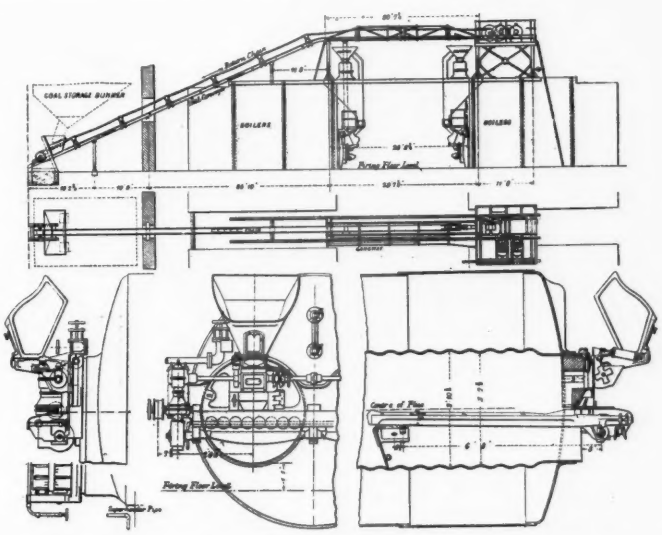
Amsterdam Municipal Electricity Works.

COALING PLANT AT THE AMSTERDAM ELECTRICITY WORKS.

The Amsterdam Municipal Electricity Works contains 16 combined Lancashire and multitubular boilers, arranged in two facing rows of eight each, which, but for slight fractional differences in dimensions, are practically identical in construction, though made by three different high-class Continental firms, eight of them having been built in Amsterdam itself by the Netherlands factory.

The Bennis automatic stokers were fitted to eight of the boilers, and their satisfactory performance induced the municipal authorities to equip the second eight boilers similarly.

The central station is situated on the canal side, and the coal is brought to it in large Rhine barges. A jib crane, travelling along the quay on a moving gantry, discharges the barges by means of empty tipping-truck bodies, of about 1-ton capacity and of V section, which are lowered into the barges from a platform 31 ft. above water level. After filling they are raised by the crane to the platform, one at a time, and deposited on wheel frames. When weighed, the trucks are pushed on rails at the same level into the coal store, and tipped where required. This coal store is a large building placed between the boiler house and the quay side, and has a storage capacity of over 2,000 cb. yd. At the middle of the store the coal can be tipped from the trucks into a crusher situated about 20 ft. below the truck platform (the crusher can also be fed from the ground level of the store by hand trimming).



Bennis Conveyor Plant and Machine Stokers Installed at Amsterdam.

Interior of the Boiler House, Amsterdam Electricity Works.

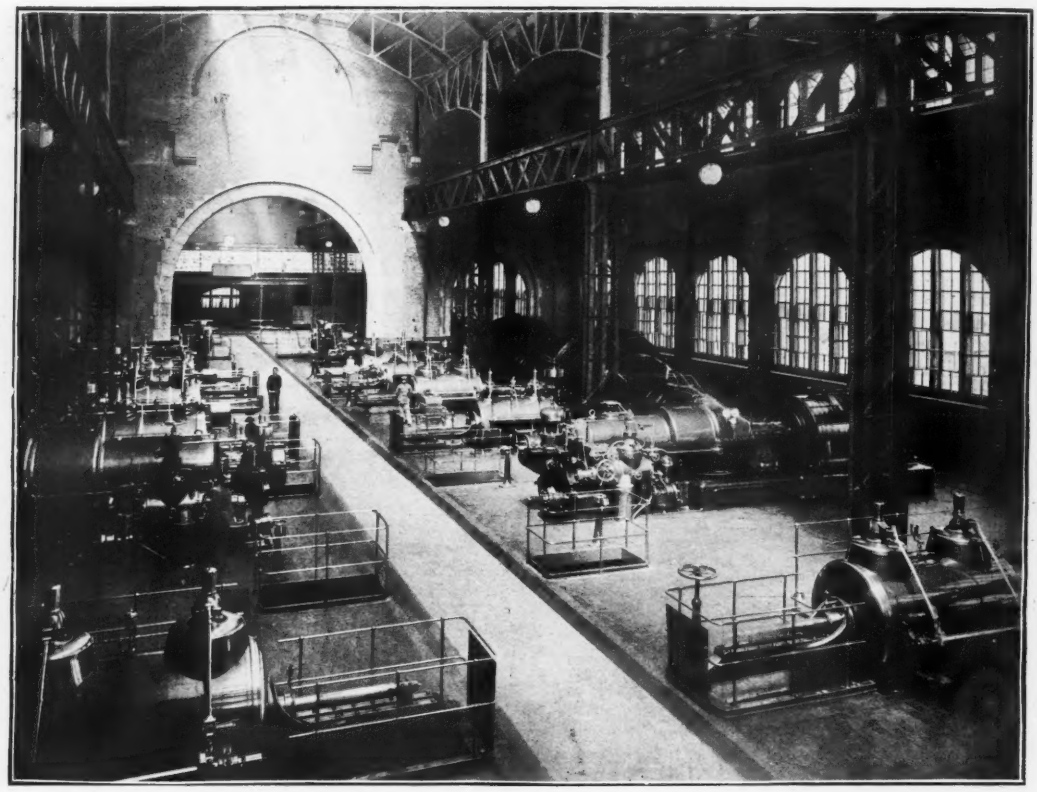
From the crusher the coal is lifted by an almost vertical bucket elevator, which delivers it again into a steel hopper of about 100 tons capacity (still within the walls of the coal store).

From the base of the hopper, at ground level, a U-link chain conveyor, supplied by Ed. Bennis & Co., Ltd., rises at an incline of 30°, passing through the wall of the coal store to a height within the boiler house of 25 ft. above the firing floor, at which level it crosses the boiler house horizontally. The total length of the conveyor is 83 ft., and it has a capacity of 25 tons per hour. It discharges at two points through automatic weigh-

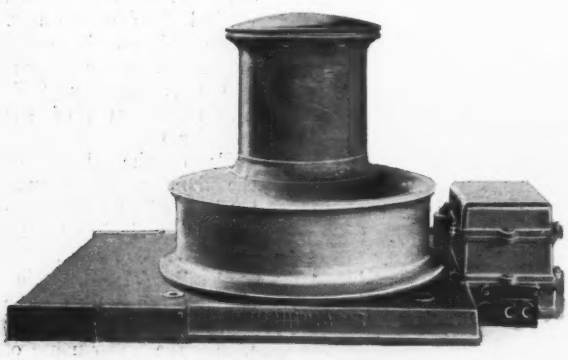
ing machines, which deliver it to scroll conveyors for distribution along the front of each range of boilers to the individual stoker hoppers.

The point of entry of the chain conveyor into the boiler house is midway along the ranges. The latter are divided, for purposes of the coal supply, into four groups of four boilers each, and the four scroll conveyors are necessarily two pairs of right and left-hand scrolls. Suitable valves are provided whereby the coal can be cut off from any boiler in any group.

The Bennis U-link conveyor is driven by a 12-H.P. motor at 475 R.P.M., situated on a driving platform at the extreme end of the conveyor on the upper level, a tension drum for tightening the chain being fitted at the bottom end, below the steel hopper mentioned. The chain moves at 60 ft. per minute in a trough 12 in. wide × 7 in. deep.



The Engine Room, showing Turbine and Reciprocating Plant, Amsterdam Electricity Works.

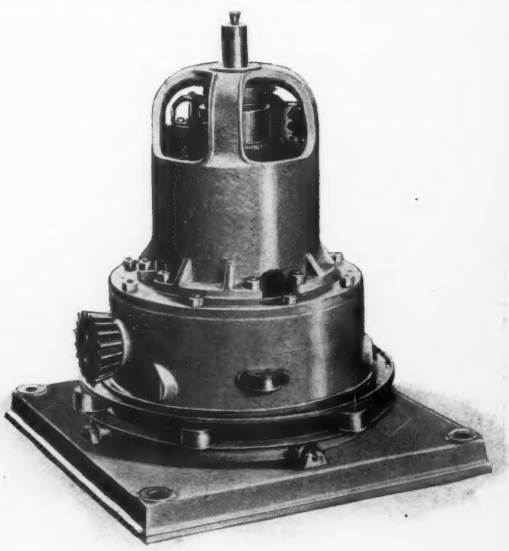


Complete Capstan with Control Box

Electric Steel. — The Stavanger Elektro-Staalverk Bolaget is the name of a new company which has been formed at Stavanger, Norway, with a capital of 450,000 kronen, to establish a plant for the electrical production of steel. The plant will have an annual capacity of 3,000 tons, and will be mainly devoted to the production of steel for shipbuilding purposes.

A NEW TYPE OF ELECTRIC CAPSTAN.

An electric capstan of novel design has recently been introduced by Messrs. Clarke, Chapman & Co., Ltd., of Gateshead, in which the motor is above ground and placed with the reduction gear inside the capstan head, thus avoiding the large cast-iron box which usually has to be let into the ground and which so frequently gives trouble on account of the sweating taking place inside.



Clarke, Chapman Capstan, with Head Removed, showing Motor, &c.

The capstan is arranged in two ways, one with the bed-plate extended to carry the controller at one end and the resistance at the other, and the other with a small square bed, in which case the control gear is placed separately.

This capstan is shown with the head removed in one of our views, in which the motor is clearly seen.

It is of the vertical type and runs at a fairly high speed; ball bearings are fitted so that very little lubrication is required, and provision is made for carrying off any surplus grease from the top bearing to prevent it getting into the motor windings. The reduction gear consists of a steel worm cut on the motor shaft, driving a machine-cut worm wheel, which in turn drives through a pair of spur gear on to the shaft of the bevel pinion which is seen outside the gear box on one of the illustrations, and which drives the capstan by means of a bevel ring bolted to the inside of it.

All the gear, with the exception of the actual bevel ring on the capstan, runs in an oil bath, and as all the gear is cut, the efficiency is very good.

The capstan is supported on a pin at the top, formed in one with the body of the motor, and at the bottom by a set of live rollers shown in the view where the capstan is removed. This arrangement brings the point of application of the pull of the rope about midway between the two points of support of the capstan, so that the pressure is equally distributed, which is preferable to having the capstan overhung from its bearing, as happens in many designs.

The capstan, too, is driven by a spur ring of larger diameter than the tread of the capstan, so that the force on the teeth is less than that applied to the rope.

It will be seen from the illustration that the capstans are generally made with two working portions, one about twice the diameter of the other, so that two rope speeds are obtained which is frequently a convenience. Although the motor is perfectly protected from the weather, it is ventilated by air entering below the capstan and escaping through holes cored in the capstan under the cover, which helps to keep the motor cool and prevent trouble from sweating.

The control gear can be of any of the usual types, and can be mounted on a bedplate, as shown on one of the views, or separately. If a solenoid-operated controller is desired, a small pedal switch fitted into a cast-iron watertight box can be supplied, the box being so designed that the pipe carrying the mains to the capstan can be screwed into opposite sides of it, the main cables passing through the box and the small leads from the pedal switch running back with the main cables to the solenoid operated controller.

"The Retrograders"?—Under the above heading a contemporary has the temerity to attack the Office of Works for running a private generating station at South Kensington. On reading that such a station is just being put down at the Imperial Institute, one glances in surprise at the date of issue to see if, by any chance, the paper is some years old. As the station in question has been in operation for something like a score of years, "retrograde" seems to be capable of an application other than that intended by the writer!

It is true that alterations are in progress (involving the erection of more high-speed, direct-coupled sets in place of others of the lengthy horizontal type) which will increase the capacity of the station, but, as the present electrical output approaches 500 KW., the station can hardly be treated as non-existent. The writer refers to the fact that the exhaust steam is used for heating purposes: he makes no mention of the fact that the primary object of the plant *is* for heating purposes, and that the electric light and power load is merely a by-product; wherefore the gibe at uneconomical non-condensing engines is beside the mark.

The public buildings mentioned as those which *will be* supplied are the Royal College of Science, the Natural History Museum, the Victoria and Albert Museum, and the Meterological (*sic*) Office. As our readers are aware, part of the Natural History Museum has been lighted from this source for several years, and the size of the installation has been growing continuously; the new College of Science has been supplied since it was built, about five years ago, but doubtless both the power and lighting loads will be considerably increased shortly by the addition of the new School of Mines, &c., just approaching completion in the Prince Consort Road; the new Post Office and Meteorological Office were connected last October; certain sections of the Victoria and Albert Museum (for instance, the Indian Section and the Science Galleries) have been connected for some years, but it is safe to say that, were the main building to be transferred also, it would require practically the whole of the additional plant to cope with its consumption alone.

The advantages of centralisation are well known, but there must always be cases where isolated generating stations of a certain size become economical when run in conjunction with other engineering requirements, such as heating (if it were intended to advocate *electric* heating for these buildings from a supply in bulk, we should anticipate a speedy rise in the price of cable and radiators); and before engineers are criticised for out-of-date methods, the critic should make sure of having up-to-date information.

NEW COMPANIES REGISTERED.

Buenos Ayres City and Suburban Tramways, Ltd. (114,031).—This company was registered on February 3rd, with a capital of £500,000 in 77,000 preference shares of £5 each and 115,000 shares of £1 each, to carry on the business of tramway, railway, omnibus and van proprietors, carriers of passengers and goods, manufacturers and repairers of and dealers in carriages and machinery and plant, appliances and apparatus used in the generation, distribution, accumulation and supply of electricity, and to adopt an agreement with the Buenos Ayres Port and City Tramways, Ltd. The subscribers (with one share each) are:—H. Spinks, 37, Fletching Road, Clapton, clerk; H. I. Robinson, 88, Dean Street, Oxford Street, W., clerk; G. Troughton, 15, Barclay Road, Fulham, S.W., shorthand writer; E. J. Summers, 104, Elthorne Road, Upper Holloway, N., secretary; G. V. Hatch, Harleyholme, Langley Road, Harrow, secretary; H. F. V. Oldham, 46, Hyde Park Gate, S.W., gentleman; T. W. Evans, Glengorm, Chislehurst Avenue, North Finchley, N., secretary. Minimum cash subscription, 7 shares. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first, subject to the right of the above-mentioned company to nominate a majority on the board; qualification, £250; remuneration, £2,000 per annum, divisible. Registered by Ashurst, Morris, Crisp and Co., 17, Throgmorton Avenue, E.C.

Ridings Arc Lamp Co., Ltd. (114,057).—This company was registered on February 4th, with a capital of £3,000 in £1 shares (500 vendors) to carry on the business of lamp manufacturers, electricians, electric telephonic and telegraphic engineers and fitters, &c., and to adopt an agreement with W. R. Ridings and W. E. Goodman. The subscribers (with one share each) are:—W. R. Ridings, Sale Bank, Sale, Cheshire, engineer; C. C. Ridings, Sale Bank, Sale, Cheshire, engineer. Private company. The number of directors is not to be less than three or more than five; W. R. Ridings is the first managing director; qualification of W. R. Ridings, 200 vendors' shares. Registered office, 16, Tib Street, Manchester.

J. H. Ballantyne & Co., Ltd. (7,775).—This company was registered in Edinburgh on January 30th, with a capital of £1,000 in £1 shares, to carry into effect an agreement between Annie F. Ballantyne and J. H. Ballantyne, and to carry on the business of contractors, manufacturers and dealers in all kinds of electrical goods. The subscribers (with one share each) are:—Annie F. Ballantyne, 80, Hyndland Road, Glasgow; J. H. Ballantyne, 49, Polwarth Gardens, Glasgow. Private company. The first directors are Annie F. Ballantyne and J. H. Ballantyne; qualification, £5. Registered office, 80, Hyndland Road, Glasgow.

A. G. Kent & Co., Ltd. (114,275).—This company was registered on February 18th, with a capital of £500 in £1 shares, to carry on the business of electrical, mechanical, hydraulic, mining and general engineers, electrical contractors, electricians, &c. The subscribers (with one share each) are:—W. R. Kent, 111, Wilton Road, Victoria, S.W., electrical engineer; Mrs. A. G. Kent, 111, Wilton Road, Victoria, S.W. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Table "A" mainly applies. Registered by Guscotte & Fowler, 1, York Buildings, Adelphi, W.C.

Armstrong, Stevens & Son, Ltd. (114,166).—This company was registered on February 10th, with a capital of £50,000 in £1 shares, to carry on the business of manufacturers of steel, chains, hinges, screws, nuts, bolts, nails, springs, wire, rivets, electric light and gas fittings, saws, incandescent lamp sockets, brass, copper, telephone and telegraph wire, &c., to acquire the freehold and leasehold premises, plant and machinery, &c., connected with the businesses of merchants, factors and drop-forge manufacturers carried on by Armstrong, Stevens & Son, at 15, Whittall Street, Birmingham, and at Armstrong Works, Walsall Road, Willenhall, Staffs. The subscribers (with one share each) are:—R. A. Stevens, 15, Whittall Street, Birmingham, manufacturer; C. H. Stevens, 15, Whittall Street, Birmingham, manufacturer; C. H. Gardner, 15, Whittall Street, Birmingham, manufacturer. Private company. The number of directors is not to be less than three or more than five; the subscribers are to appoint the first; qualification, £500; remuneration as fixed by the company. Registered office, 15, Whittall Street, Birmingham.

Watlington & Co., Ltd. (114,141).—This company was registered on February 9th, with a capital of £5,000 in £1 shares, to take over the business carried on by V. Watlington, J. F. Caine and S. C. Hackney, and to carry on the business of manufacturers of and dealers in materials of all kinds used in connection with electrical or mechanical engineering, &c. The subscribers (with one share each) are:—G. Addison, 2, Bond Court, Walbrook, E.C., solicitor; H. G. Brown, 2, Bond Court, Walbrook, E.C., solicitor; F. H. G. Branson, 2, Bond Court, Walbrook, E.C., solicitor. Private company. The number of directors is not to be less than two or more than five; the first are J. F. Caine, S. C. Hackney and F. Bourne. No remuneration unless sanctioned by special resolution. Registered office, Moorgate Station Chambers, E.C.

Midget Electric Lamp Manufacturing Co., Ltd. (114,092).—This company was registered on February 7th, with a capital of £2,500 in £1 shares (500 pref.), to carry on the business of electric manufacturers, manufacturers of electric filaments, globes, shades, cylinders, boxes or bulbs, air pumps, motors, dynamos, &c., and to adopt an agreement with H. E. Clerk. The subscribers (with one share each) are:—A. H. Mathewson, 138, Bravington Road, Paddington, W., clerk; L. Walton, 31, Oakfield Road, Croydon, clerk. Private company. The number of directors is not to be less than two or more than four; the first are H. E. Clerk (governing director) and J. Meszaros (permanent manager, special qualification 300 ordinary shares); remuneration of J. Meszaros as fixed by agreement. Registered by E. Chace Carr, 11-12, Great Tower Street, E.C.

Lord-Howe Electrical Engineering Co., Ltd. (114,185).—This company has just been registered, with a capital of £1,000 in £1 shares, to carry on the business of electrical, mechanical and ventilating engineers, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic and other appliances, and to adopt an agreement with S. Lord, L. F. S. Sington, Ann Simpson and R. A. Stewart. The subscribers (with one share each) are:—S. Lord, 20, Roxburgh Avenue, Birkenhead, electrical engineer; L. F. S. Sington, Lyndhurst, 13, Ivanhoe Road, Sefton Park, Liverpool, electrical engineer. Private company. The number of directors is not to be less than two or more than seven; the first are S. Lord and L. F. Sington. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Kilowatt Publishing Co., Ltd. (90,715).—Issue on December 31st of £12 10s. debentures, part of a series of which particulars have already been filed.

Northampton Electric Light and Power Co., Ltd. (28,640).—Debenture dated January 13th, 1911, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Northamptonshire Union Bank, Ltd. Also debenture dated January 30th, 1911, to secure all moneys due or to become due from the company to the Northamptonshire Union Bank, Ltd., charged on the company's undertaking and property, present and future, including uncalled capital.

Cowper-Coles Engineering Co., Ltd.—Particulars of £8,000 debentures, created by resolutions of January 23rd and 31st, 1911, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £7,700. Property charged: The company's undertaking and property, present and future. No trustees.

Suppliers' Construction Co., Ltd. (66,081).—Return dated December 29th, 1910, filed January 4th, 1911. Capital £350,000 in £5 shares. All shares taken up. £350,000 paid. Mortgages and charges: Nil.

Amazon Telegraph Co., Ltd.—A memorandum of satisfaction in full of two mortgages or charges dated July 8th, 1901, and July 11th, 1905, securing £150,000 and £75,000 respectively, has been filed.

British Insulated and Helsby Cables, Ltd. (52,285).—Trust deed dated November 29th, 1910 (supplemental to deeds of July 22nd, 1901, May 21st, 1902, and November 28th, 1910, securing £500,000 5 per cent. mortgage debenture stock), charged on the company's undertaking and property for the time being (subject to deeds securing £500,000 4½ per cent. first mortgage debenture stock), including various freeholds and leaseholds. Trustees: Hon. Arthur Stanley, M.P., and J. S. Harmood-Banner, M.P.

"Float" Electric Co., Ltd. (107,336).—Debenture dated January 17th, 1911, to secure £2,800 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: C. J. W. Blundell, Blundell House, Campden Hill, W.

Thompson, Ritchie & Co., Ltd. (35,835).—Return dated January 13th, filed January 17th, 1911. Capital, £15,000 in £10 shares (700 preference). 700 preference and 190 ordinary shares taken up. £7,200 paid. £1,700 considered as paid. Mortgages and charges: £2,500.

Durham and District Electric Traction Co., Ltd. (79,285).—Return dated December 28th, 1910, filed January 31st, 1911. Capital, £30,000 in £1 shares. 7 shares taken up. £7 paid. Mortgages and charges: Nil.

Douglas Southern Electric Tramways, Ltd. (45,701).—Return dated December 8th, filed December 19th, 1910. Capital, £50,000 in £1 shares (30,000 preference). 25,973 preference and 15,472 ordinary shares taken up. £1 per share called up on 12,566 preference and 5,804 ordinary. £18,370 paid. £23,075 considered as paid on 13,407 preference and 9,668 ordinary. Mortgages and charges: Nil.

Hankow Light and Power Co., Ltd. (87,331).—Cancellation on February 1st, 1911, of series of debentures authorised May 24th, 1907, intended to secure £10,000 (none of which debentures have ever been issued). Also satisfaction in full on January 26th, 1911 (*a*) of mortgage dated December 18th, 1908, securing £1,000, and (*b*) of mortgage dated April 3rd, 1908, securing 38,450.57 taels (say, £4,405 15s. 9d.).

CITY NOTES.

The National Telephone Co., Ltd.

THIRTY years ago, in 1881, the National Telephone Co. was registered, with a total capital of £600,000, of which one-fourth was represented by 15,000 preference shares of £10 each, and the remainder was in 90,000 ordinary shares of £5 each. Bit by bit, as other undertakings were bought out and the company extended its manifold ramifications, the capital increased, and various reconstitutions of the account were undertaken, so that to-day the position has grown into the following figures:—

Stock or share.	Amount issued.	Market price.	Market valuation.
Six per cent. preferred stock ..	£2,225,000	104½	£2,325,125
Deferred stock	3,725,000	141	5,252,250
Six per cent. first preference shares	150,000	10⅜	155,625
Six per cent. second preference shares	150,000	10⅜	159,375
Five per cent. third preference shares	1,250,000	6⅜	1,593,750
Three and a half per cent. deb. stock	2,000,000	99	1,800,000
Four per cent. debenture stock ..	1,983,593	100	1,983,593
Totals	£11,483,593		£13,269,718

This is the position as it stands now, and with the end of the company in sight, its remaining life being ten months only, a lively speculation has sprung up in the deferred stock and the third preference shares, which within the past fornight have been carried up to 146 and 6⅜ respectively. Allowing for deduction last account day of the dividends on both, the present quotations are little short of the top prices in their recent history. Fifteen years ago, in 1896, the then £5 ordinary shares mounted to 8½, which is equal to 162½ for the equivalent in stock, but for the past half-decade the variations have been as follows in the prices of the preferred and deferred stocks and the third preference shares:—

	1906.	1907.	1908.	1909.	1910.
Preferred stock—					
Highest	114⅜	111½	112½	110⅜	108½
Lowest	106½	104¼	106	105⅛	103⅛
Deferred stock—					
Highest	113⅜	112½	122	127⅛	130
Lowest	105½	101	107	116	121
Third preference—					
Highest	6	5 15/16	6	5⅝	5⅝
Lowest	5¼	5⅛	5 7/16	5⅛	5 7/16

So far as the prior stocks and shares are concerned, it is now taken for granted that the two classes of debenture stocks and the first and second preference shares will be paid off at their par value, which is, of course, £100 for the stocks and £10 for the shares. Likewise, it is practically settled that the preferred stock will receive its par value of £100, with £5 premium in addition, as provided for in the case of a winding up. There seems to be some forlorn hope that the second preference proprietors may get a little extra in the final event but no ustification for such a view can be obtained from the joint opinion of eminent counsel. Therefore, the real speculation centres around the sum which is likely to remain over for division amongst the holders of the third preference shares and the deferred stock, which, added together, amount to £4,975,000 nominal, capitalised by the market—as our first table shows—at £6,846,000, the latter being just over one-half of the total market capitalisation of the company. An element of uncertainty is introduced by the claim of the third preference shareholders being somewhat loosely understood even by those best qualified to judge, but the Stock Exchange opinion, whatever that may be worth, is indicated by the rapid manner in which the price of the shares has risen in conjunction with that of the deferred stock. In considering the question of repayment, it is important to bear in mind that at the option of the Government three-fourths of the purchase-money and, with the consent of the company, the whole of the purchase money may be paid by way of terminable annuities running over a period of twenty years.

The President of the National Telephone Co., at the meeting last Thursday week, February 23rd, very prudently remarked that he would not "enter the clouds of speculation." He pointed out that the capital account had been built up by expenditure on the purchase of businesses and on construction, whereas the value to be obtained under the purchase agreement, as the board understood it, was to be based upon the cost price of such assets as at December 31st next, less a proper sum for depreciation. It was to provide for possible depreciation of value as between those two methods that the directors had made large transfers to depreciation. "Uncertainty," added Mr. George Franklin significantly, "as to the purchase price would probably only be ended as the result of arbitration," and this is made the clearer by the company's entire dissent from the views of the Postmaster-General on the point of the Government's objection to purchase a quantity of the land, plant and buildings in competitive exchange areas. The Railway and Canal Commissioners, who are to be the arbitration tribunal, had already been approached on a further difference of opinion between the Postmaster and the company, from which it may be inferred that both parties are willing to get on with the work as expeditiously as possible, perhaps in order to get the ground cleared as far as may be in advance before the final tug-of-war comes along. The company is to be taken over on "tramway-terms," that is, shortly, as a going concern without allowance being made for goodwill, reserving its cash and similar assets for distribution amongst its shareholders.

According to the balance-sheet of the National Telephone Co., up to the end of December last, the assets stand at £16,184,566. Deducting 10 per cent. as a precautionary measure, the amount remaining comes to, say, 14½ million pounds sterling, to which must be added appropriations in respect of the working for the present year. Looking back to the first table given above, it will be seen that the capital repayable at par, *i.e.*, the debenture stocks and the first and second preference shares, totals £4,283,593, to which the preferred stock, allowing for its 5 per cent. premium, comes on and makes £6,619,843, leaving the deferred stock and the third preference shares represented by £4,975,000 at their nominal values. If we take the 6½ millions in the last sentence from the 14½ millions estimated above, there will be left 8 millions sterling for division between the third preference and the deferred proprietors, the market value of whose holdings, as set out in the final column of the above calculation, is £6,846,000 at current quotations. These figures, on paper, would more than warrant the big rises that have lately occurred, but no cautious critic would care to suggest even that full faith should be put in them, because, to begin with, the basis of the whole structure is the amount stated in the company's balance-sheet as the value of assets, much of which will depend upon the agreement that is only likely to be arrived at between the Government and the National Telephone Co. after a good deal of hard work on the part of the arbitrators. The question of depreciation is so all-important that to attempt a measure of it is simply to enter those clouds of speculation into whose nebulous mists the chairman of the company has declined to be drawn.

British Electric Transformer Co., Ltd.

THE annual general meeting was held on Monday, at Salisbury House, E.C., Mr. J. F. Albright presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, page 315) dealing first with the accounts, said there was a net addition to the patents and goodwill account of £181, in respect of fees on account of patents which were improvements upon their original ones. Mr. A. F. Berry and the members of the technical staff were constantly endeavouring to improve the business, and the question of taking out further patents and keeping their position up to date were things at which they were

constantly working. The preliminary expenses were not disposed of altogether as an asset. Freehold buildings, plant, &c., had been decreased by about £58 due to the disposal of some generating plant purchased several years ago. With the addition to the reserve now proposed they would have a sum of £6,800 as a reserve for depreciation under those heads. The item for stock and materials was about £2,000 more than last year. That, of course, was a fluctuating item, and the increase was due to additional work they had in hand compared with the corresponding period last year. They had written off £3,186 from investments during the year, which represented a loss on some shares sold and on the conversion and reduction of some shares which they had previously received in part payment of accounts, together with some shares held in companies now in liquidation. With the addition of the £5,000 now proposed, the reserve would amount to about £7,886. They had continued their policy of placing considerable sums to reserve to meet the contingency of depreciation in their investments, which was a relic of mistakes in previous years. The result of that policy was that their investment account was pretty nearly cleared up, and out of the £5,000 they carried to reserve something like £3,000 to £4,000 could be put against their patents and goodwill, so that a fairly substantial beginning had been made towards redeeming his promise of two years ago. Sundry debtors amounted to about £10,000 more than last year; they were, however, all considered good, and the increment was mainly due to the increase in their sales for the last two months of the year under review. Since December 31st about £10,000 of these debts had been paid. Including the amount brought forward, they had a balance of £13,441 to dispose of. They recommended that £1,000 should be placed to depreciation reserve, which was the amount they usually put on one side for that purpose. They proposed to add £5,000 to the reserve which was £1,000 more than last year, but the directors preferred the conservative course of placing as large sums as possible to reserve, whilst they were enjoying times of prosperity, and he hoped the shareholders would agree to that cautious policy. Subject to the current year's accounts being as favourable as those for the past 12 months, it was their intention to continue their policy of steadily building up the reserve. After paying the preference shareholders in full, they proposed to pay 6 per cent. on the ordinary shares. He thought the holders of those shares were to be congratulated on the fact that their dividend had gone up from 3½ per cent. in 1908 to 5 per cent. in 1909, and now it was 6 per cent. With very little straining they might have paid more than 6 per cent., but he thought the shareholders would agree that in view of their past experience they were right in aiming rather at securing the permanence and general strength of the company than in paying unduly high dividends. To sum up, compared with last year the profit was about £550 more; they proposed to add £1,000 more to the reserve, to pay the ordinary shareholders £694 more by way of dividend, and to carry forward about £120 more than in the previous year. They had gone steadily forward during the year, securing their fair share of the orders that were going, and he was glad to say that although prices did not improve much, the volume of orders to be placed was better. They had entered into an agreement with the Berry Construction Co., Ltd. That company sold what was known as the "Tricity" cooking apparatus, which was being manufactured by the British Transformer Co. The development of such a business naturally demanded time, but the board believed that the system was the best on the market, and they also believed that there would be a great demand for electrical cooking apparatus in the future. Even now the manufacture of the apparatus was forming a serious part of their work, and he believed it would become increasingly important. As to the general prospects of their company, he did not care to prophesy, but the commencement of 1911 found them with 100 per cent. in value more orders in hand than at the commencement of 1910. Therefore, everything pointed to the current year being a prosperous one.

Mr. A. F. Berry, in seconding the motion, remarked that the original shareholders had received back 96 per cent. of their capital in dividends, while, at the same time, the capital had increased by about 50 per cent. That had been done during a period which was about the worst that the electrical engineering industry had ever had to pass through.

The report was adopted.

Yorkshire Electric Power Co.

The annual meeting was held at Leeds, on 21st ult., Mr. A. G. Lupton presiding. The Chairman said the progress of the company was definite and satisfactory, and showed that they had now turned the corner. They believed they were on the road to success, though there must still be some time before a dividend on the ordinary shares could be reached. The revenue account indicated a growth in the receipts at the rate of 45 per cent., from £25,672 in 1909, to £37,543 in 1910, whilst the gross profit had increased at the rate of 85 per cent., from £6,087 in 1909 to £11,307 in 1910. The percentage of expenses to receipts had decreased from 84 per cent. in 1908 to 72 per cent. in 1909, and 69 per cent. in 1910. The net revenue account showed an increased charge of £1,381 for interest paid on the mortgage accounts, but the net balance of profit after paying this had been increased from £2,664 in 1909 to £6,503 for 1910. A sum of £34,669 had been expended on mains. This included the cost of completing the eastern mains to Whitwood, Castleford, and Allerton Bywater, and in erecting the western mains to Southowram, Elland, Greetland, Stainland, Sowerby Bridge, and Hipperholme; and the southern mains from Clayton West to Barugh, Silkstone and Penistone. The demand coming from these mains, and that from new connections on the old mains, as well as from the improved state of the district, had made the staff very anxious to get possession of the fourth turbine, which was now running its contract trials at Thornhill. It was impossible for the company to decline to lay mains where profitable business was offered, but these new districts always required considerable time for enough customers to be connected to make the line remunerative, and the policy of the directors was to make these extensions in as conservative a manner as possible, and so to nurse the resources of the company.

The report was adopted.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Montreal Water and Power Co.—Further issue of £20,000 4½ per cent. first mortgage prior lien gold bonds of £100 each, Nos. 4,418 to 4,617.

Sao Paulo Tramway, Light and Power Co., Ltd.—6,000 additional shares of $100 each.

United Electric Tramways of Monte Video, Ltd.—Further issue of 10,723 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 79,278 to 80,000 and 160,001 to 170,000.

South Metropolitan Electric Light and Power Co., Ltd.—Warrants for dividends on the 7 per cent. cumulative first preference and 6 per cent. cumulative second preference shares for last half-year have been posted.

Dublin and Lucan Electric Railway Co.—Mr. W. Mooney presided at the half-yearly meeting held on February 23rd. He said that the receipts from all sources were better by £240. They were placing £350 toward the development of the scheme which had been in operation for some time, for supplying surplus electric current for lighting purposes; that sum represented the net profit received from that source during the period it had been in operation. The report was adopted.

Scarborough Electric Supply Co., Ltd.—The directors' report states that the amount of energy supplied for general lighting and other purposes during the year has increased to 558,492 units, as against 546,022 units for 1909, but owing to the Tramways Co. having discontinued its winter service and its consequent failure to take its contract supply of electrical energy, the total number of units supplied for all purposes has fallen from 846,022 to 832,879 units. The cheapening of the electric light due to the superior economy of the metallic-filament lamps continues to attract new consumers, while there also is an increased use of electric energy for power and heating. During the year a showroom of electrical fittings and appliances has been opened at the company's office, with satisfactory results. After placing £1,000 to depreciation account, there is a balance on revenue account of £3,766. The directors recommend a dividend at the rate of 3 per cent. for the year, absorbing £3,000, leaving to be carried forward £766.

Metropolitan Electric Supply Co., Ltd.—The directors recommend a dividend for the half-year ended December 31st last, at the rate of 6 per cent. per annum, making 5 per cent. for the year 1910. This is the same rate as for 1909.

Northallerton Electric Light and Power Co., Ltd.—This company held its annual meeting at Northallerton on February 22nd. The accounts showed a net profit of £202, as against £80 for 1909. The profit was placed to reserve fund. Mr. J. Hutton presided, and said that the business was improving, and shareholders must feel more satisfied than for some time. The report was adopted.

County of London Electric Supply Co., Ltd.—The directors have declared a final dividend upon the preference shares at the rate of 6 per cent. per annum, less income-tax, and on the ordinary shares at the rate of 6 per cent. per annum, less income-tax, for the half-year to December 31st, making 5 per cent. for the year on the ordinary shares. £20,000 has been placed to reserve for depreciation. Last year the dividend was at the same rate.

Harper Electric Piano (1910), Ltd.—The directors have declared a dividend at the rate of 6 per cent. per annum on the participating ordinary shares for the half-year ending December, 1910.

Newcastle-upon-Tyne Electric Supply Co.—The directors recommend a dividend of 4 per cent. for the year (on account of which an interim dividend of 1½ per cent. has been paid) on the ordinary shares. This is at the same rate as for 1909.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended January 27th, 1911, amounted to 537,547, compared with 482,672 units in the corresponding four weeks in 1910.

Continental.—Spain.—The Sociedad Barcelonesa de Electricidad, of Barcelona, is declaring a dividend of 8 per cent. for the last financial year, as contrasted with 7½ per cent. in the preceding 12 months.

Belgium.—The balance-sheet of the Société de l'Electricité de Seraing et Extensions for the last financial year shows a profit of £2,646, as compared with £3,684 in the preceding 12 months. A dividend at the rate of 2 per cent. is being declared.

Anglo-American Telegraph Co., Ltd.

An extraordinary general meeting was held on Friday last at Winchester House, E.C., Mr. F. A. Bevan presiding.

The Chairman said the only business before the meeting was the consideration of the following resolution which he moved:—

That the provisions of the company's memorandum of association with respect to the objects of the company be altered by adding at the end thereof the words following, that is to say:—"And in addition to the above to do all or any of the things following, that is to say:—

(1) To establish and maintain between any places in any part of the world any system of communication whether by telegraph, telephone, wireless telegraph or otherwise, and to work, let, manage, control or superintend the same. (2) To manufacture, buy, sell, prepare and deal in submarine and other cables and all kinds of electrical and mechanical apparatus, and generally to carry on the business of a mechanical and electrical engineer. (3) To enter into arrangements with any Governments or authorities, supreme, municipal, local or otherwise, that may seem conducive to the company's objects, or any of them, and to obtain from any such Government or authority any rights, privileges and concessions which the company may think it desirable to obtain, and to carry out, exercise and comply with any such arrangements, rights, privileges and concessions. (4) To apply for, purchase, or otherwise acquire any patents, brevets d'invention, licences, concessions and the like conferring any exclusive or non-exclusive or limited rights to use, or any secret or other information as to any invention which may seem capable of being used for any of the purposes of the company, or the acquisition of which may seem calculated directly or indirectly to benefit the company, and to use, exercise, develop, or grant licences in respect of, or otherwise turn to account the property, rights and information so acquired. (5) To acquire and undertake the whole or any part of the business property and liabilities of any company, firm, or person, carrying on any business which the company is authorised to carry on or possessed of property suitable for the purposes of this company. (6) To enter into partnership or into any arrangement for sharing profits, union of interests, co-operation, joint adventure, reciprocal concession or control, or otherwise with any person or company carrying on or engaged in or about to carry on or engage in any business or transaction which this company is authorised to carry on or engage in or any business or transaction capable of being conducted so as directly or indirectly to benefit this company. (7) To lend money on cable or other property or otherwise assist any such person or company. (8) To take or otherwise acquire and hold shares in any other company having objects altogether or in part similar to those of this company, or carrying on any business capable of being conducted so as directly or indirectly to benefit this company. (9) To promote any company or companies for the purpose of acquiring any property and rights of this company, and for any other purpose which may seem directly or indirectly calculated to benefit this company. (10) Generally to purchase, take on lease, or in exchange, hire or otherwise acquire any real or personal property, and any rights and privileges which the company may think necessary or convenient for the purposes of its business. (11) To construct, improve, maintain, develop, work, manage, carry out and control any roads, ways, tramways, ships, vessels, reservoirs, watercourses, wharves, manufactories, electric works, shops, stores and other works and conveniences which may seem calculated directly or indirectly to advance the company's interest and to contribute to subsidise or otherwise assist, or take part in the construction, improvement, maintenance, working management, carrying on or control thereof. (12) To borrow or raise money in such manner as the company may think fit, and in particular by the issue of debentures or debenture stock, perpetual or otherwise, charged upon all or any of the company's property, both present and future, including its uncalled capital, and to purchase, redeem, or pay off any such securities. (13) To undertake and execute any trusts, the undertaking whereof may seem desirable in the interest of the company, and either gratuitously or otherwise. (14) To stipulate for and obtain by contract or otherwise any rights, privileges, guarantees or advantages for the benefit of the company's members, debenture or debenture stockholders or creditors. (15) To sell or dispose of any part of the company's undertaking for such consideration as the company may think fit, and in particular for shares guaranteed, preference or ordinary debentures or debenture stock interest-bearing certificates, with or without collateral leased lines, stock or bonds, securities or obligation of any other company having objects altogether or in part similar to those of this company. (16) To obtain any provisional order or Act of Parliament for enabling the company to carry any of its objects into effect or for effecting any modification of the company's constitution, or for any other purpose which may seem expedient, and to oppose any proceedings or applications which may seem calculated directly or indirectly to prejudice the company's interest. (17) To procure the company to be registered or recognised in any foreign country or place. (18) To sell, improve, manage, develop, exchange, lease, mortgage, enfranchise, dispose of, turn to account, or otherwise deal with all, or any part of, the property and rights of the company. (19) To do all or any of the above things in any part of the world, and as principals, agents, contractors, trustees or otherwise, and by or through trustees, agents or otherwise, and either alone or in conjunction with others. (20) To do all such other things as may seem to the company incidental or conducive to the attainment of the above objects or any of them."

He wished it to be clearly understood that they were only asked to pass that resolution. It was quite true that the alterations in the memorandum of association had been drawn up in view of the possible or proposed agreement with the Western Union Telegraph Co., but they were not going to enter into the question of that agreement that day. The resolution brought the company's memorandum up to date. It was compiled many years ago, and memorandums nowadays gave very much wider powers than did their's originally. The present alterations had been made under the advice of counsel, and they embodied all those changes and expansions which would be necessary before they could enter into any agreement for disposing of the company. At present they were not in the position to make any agreement.

Sir Gerald Fitzgerald seconded the resolution.

Mr. Morris asked whether in the event of the agreement with the Western Union being carried out, it was the intention of the directors to embark in other business?

The Chairman: No, sir.

Mr. Tucker inquired whether the alterations would have been proposed if there had not been any negotiations with the Western Union?

Mr. Hardcastle asked whether the words in Clause 15 "to sell or dispose of any part of the company's undertaking" included power to sell and dispose of the whole undertaking.

Mr. R. Stevens said that the proposed alterations appeared so drastic and far-reaching that he thought the meeting should be adjourned in order to give the shareholders an opportunity of considering the matter. He noticed that the directors took power to manufacture cables. He should have thought that they would have been able to buy any cable they wanted cheaper than by manufacturing it. Then they were asked to further increase the capital—what further capital could they ever require?

The Chairman said he would remind the meeting that because the directors took certain powers, it did not follow that they intended to use them.

Mr. Karslake, the solicitor, in replying on the discussion, said he wished to make it clear that the agreement would be submitted to another meeting later on. The alterations had been made in view of the proposed agreement with the Western Union, because as their articles stood at present they could not enter even into a conditional agreement. The sale of the whole undertaking could only be made with the sanction of the shareholders at a special meeting.

The Chairman said he would like to emphatically state that when the agreement had been fully prepared and settled with the Western Union it would be put before the shareholders, and they would have full notice so that they would have ample time to consider it. There was not the least intention to go behind the backs of the shareholders in any way.

The resolution was then carried with one dissentient.

London Electric Supply Corporation, Ltd.

The annual meeting was held on Friday last at Winchester House, E.C., the Earl of Crawford, K.T., in the chair.

Mr. R. D. Norton proposed the adoption of the report (see Electrical Review, page 311), and said that no doubt the shareholders would be surprised that, although the company had sold 3,000,000 more units than in the preceding year, the revenue had only increased by £2,500—little more, in fact, than the sum required to pay a six months' dividend on their preference shares. The result was that they were only able to recommend the 6 per cent. dividend on the preference shares and 2 per cent. on the ordinary, in addition to adding £5,000 to reserve, bringing that fund up to £72,500. Every week practically had told the tale of an increased output and a diminished cost, but they had been obliged to sell at a cheaper rate. The agreements which, a year ago, were being negotiated with the Westminster and the St. James' Companies were now accomplished facts, and had been in operation since June last. The result of the agreement was that the two companies paid them an annual rental, provided a sinking fund for replacing the £130,000 of capital expended by them in the district, and took over the management of the business. They thus secured for the remainder of their 20 years' tenure a fixed annual payment equivalent to their net profits in the year 1908, plus the return of their capital. Further, they were relieved from the necessity of continuing a competition which was as damaging as it was inevitable. They were to continue to supply all the current to those who required it, and they received from the two companies a fixed price per unit for the current taken from them, and there their responsibility ended. Having quoted with approval the remarks of Mr. Leaf at the meeting of the St. James' and Pall Mall Co. in reference to the satisfactory nature of the agreement, Mr. Norton said it was well to remember that it was the first-fruits of the London Electric Supply Act of 1908. The board had not entered into the agreement without great consideration. As an alternative, they could have plunged into more vigorous competition, but they came to the conclusion that peace would pay them better than war. It was on the sale for power purposes that they pinned their hopes, and they intended to concentrate their energies chiefly to that end. They already had ample materials at hand for judging of the advantage and economy resulting to suburban traffic from electrification, and it was certain that what one railway had tried successfully others would imitate. The London and Brighton Railway was so satisfied with its experiment that it had already carried out the electrification of its line to the Crystal Palace, and intended afterwards to continue it to Croydon, if not further, and it could not be long before other companies would follow suit. From the position of their station on the river with three of the southern railways traversing their area, and with their successful experience to guide them, they were in a better position than any other company to give a supply for that purpose. They had entered into a new 17 years' contract with the Brighton Co. to give them current up to a maximum of 30 million units, their last year's demand having been for 5 millions. To secure that contract they had had to reduce the price. The new contract provided a sliding scale, varying according to the amount taken, between a maximum of ·85d. and a minimum of ·50d., and it was that new scale of charges which explained the small increase in the revenue last year in spite of the large increase in the sale of units. The more units they generated, the more cheaply they could do it. In the current year they expected to sell the Brighton Co. not less than 10 million units, and in the following year probably far more. The cost of generation was constantly falling, and with it the price of current. The maximum price under their new contract with the Brighton Railway was as much below that of the original contract as that was below the price they got from the L.C.C.; but that did not alarm them. On the contrary, their engineers were convinced that as soon as their new turbine plant was installed and working there would be a saving per unit in coal alone of 25 per cent. That new plant would enable them to nearly meet the maximum demand under the new contract, and when that threatened to be exceeded they had plenty of room at their station for more, and he did not think there was any reason to doubt but that the additional capital would be forthcoming.

Mr. R. Stewart Bain, the managing director, in seconding the motion, said that the capital expenditure last year—£14,950—was the smallest sum they had spent for many years. It was made up principally of two items—£8,600 for mains, and £5,200 for plant and machinery. The turbine plant of 14,000 H.P. which they had

ordered for the new contract for the Brighton Railway, together with the additional boiler power required, the extension of the condensing plant, and the new traction mains, would necessitate a considerable addition to capital expenditure during this and next year. The units sold last year showed an increase of 3¼ millions; 2,366,000, or about 70 per cent. being for traction purposes, and 844,900, equal to about 30 per cent. for power, and only about 20,000 being for lighting. While the cost obtained per unit showed a decrease, the expenditure in the cost of production also showed a satisfactory diminution. The works cost for the year was ·56d. per unit, as compared with ·66d. last year, a reduction of 15 per cent., and the total cost was 1·03d. per unit, as compared with 1·26d., a reduction of 18¼ per cent. It was expected that the new turbine plant would be running during the last quarter of the year, when the expenses of production would be still further reduced. Coal showed an increase of £3,000 for the year, that being the principal increase in their expenditure. The actual cost of coal per unit sold was ·32d., as compared with ·35d. last year, a decrease of 8½ per cent., the lowest cost they had so far achieved. Referring to the Bill promoted by the London Underground Electric Railways Co. in the present session of Parliament, Mr. Bain said that as the measure affected nearly all the authorised undertakers in London, both companies and municipalities, it would be strenuously opposed, and all the electric supply companies had joined together with that object. The powers sought in the Bills were entirely foreign to the business of a railway company, and he thought it was extremely improbable that Parliament would pass them, but it seemed very unfair that with only 20 years of their concession to run the electric supply companies should have to bear the cost of a Parliamentary fight in order to defend themselves against attacks of this kind.

Mr. Cripps said that as one who had for many years past been consulted in a professional capacity by many of the electric lighting company's in reference to Parliamentary proceedings, he was very deeply interested in the question of the future of the companies. The enactment which was embodied in the Bill of 1908 followed a suggestion which he made to the companies many years ago. He came to the conclusion, in having to advise how best to resist attacks upon them, that the then existing condition of things was not satisfactory either to the companies or the consumers. Most of them adopted his suggestion that the ultimate solution was to be found not in competition, but in working together in the interests of the consumers, and incidentally in the interests of the shareholders. He was very pleased that that company was the first to take advantage of the new Act, and in his opinion it was extremely important that the principle should, as far as possible, be extended among all the companies in London. There were a very large number of generating stations in London, a very large proportion of which might be economically put on one side, and London might be much better supplied by some system of combination. A feeling of that sort was, he was glad to think, gradually growing. He would like to see attention given to the question, as to how far it might be possible, following the precedent which existed in the case of the gas companies, to put the whole business of the supply of electric power and light in London into the hands of some body which, directly representing the companies, might be able to work with the separate companies themselves to the common advantage. He was certain that the interests of all classes of consumers would be best served by the companies putting their heads together and endeavouring to devise some comprehensive system of supply. With regard to the Bill of the London Electric Railways Co., he considered that the project deserved all the condemnation which Mr. Bain had given it. He (Mr. Cripps) was glad to think that those companies were managed by reasonable and practical people, and he hoped and believed that a means would be found of settling the matter without a costly contest in Parliament.

The Chairman said the board of that company had long recognised that combination was the right thing, but for 20 years Parliament had prevented the companies from linking up. Last year was the first time they obtained that power, and the result was the agreement which had been entered into between themselves and the Westminster and St. James' companies. He believed the start which they had made would go a great way towards making a confraternity of the various companies in the future to help themselves and promote the interests of the consumers.

The report was then adopted.

Newcastle and District Electric Lighting Co., Ltd.

The directors' report for the year ending December 31st 1910, states that the number of units sold was 12,234,106 as against 10,875,205 in 1909, an increase of 12·5 per cent. for the year. The result of the year's working is as follows:—Gross profit at Newcastle works as per profit and loss account £21,567, gross profit at Lemington and Newburn works £2,541, transfer fees £5, add £2,938 brought forward making £27,051, less interest on debenture stock, temporary loans, &c., £12,705, directors', trustees' and auditors' fees, income-tax, leasehold redemption fund, &c., £1,146 leaving £13,200, deduct interim dividend paid August 23rd, 1910, £4,196, leaving an available balance of £9,004. The directors recommend a dividend at the rate of 3 per cent. per annum (less income-tax) for the half-year ended December 31st last, absorbing £4,197, and making, with the interim dividend paid in August, 3 per cent. for the year leaving a balance of £4,807 to be carried forward. The additional cost of coal for the year 1910, labour disturbances, and other causes militated against any large increase in the profits. Contracts have been made for the supply of coal over the whole of this year at reduced prices, and the demand for the supply of electrical energy both for power and lighting purposes having greatly increased, the directors look forward to improved results during the present year. The company, through the addition of new consumers, has now overcome the decreased consumption of electrical energy due to the introduction of metal-filament lamps. The whole of the plant and machinery, together with buildings, &c., owned by the company have been maintained in a complete state of efficiency out of revenue during the year. The Newburn sub-station continues to show good results which will further improve this year with the general improvement in trade. The auditors in their certificate mention that no provision has been made for depreciation in these accounts.

National Telephone Co., Ltd.

Mr. George Franklin presided on the 23rd ult. over the forty-seventh ordinary general meeting of the above company, held at Hamilton House, Victoria Embankment.

The Chairman, in moving the adoption of the report (see Electrical Review, page 269), said it was in every respect the most satisfactory ever presented. With respect to the accounts, in spite of the restrictions in capital expenditure, unhappily due to the shortly terminating period of licence, the results indicated at any rate the company's determination, whatever else might happen, to do its duty to the public. There had been added 14,324 new stations, making 30,610 for the whole year, and they now had a grand total of 534,253 stations. It was true that this had been accomplished as a result of using up what was known as spare capacity, but it was evident that when the Postmaster-General took over the undertaking there would be a much larger income than would otherwise be the case. As to whether the Postmaster-General would rather have the spare plant or the income, that was for him to consider. The income accrued in respect of the business for the half-year was £1,744,111, as compared with £1,599,989 in the last half-year, or an increase of £144,121. From that had to be deducted Post Office royalties amounting to £167,613 against £153,856, an increase of £13,756, leaving a net income of £1,576,498, as compared with £1,446,133, an increase of £130,365. Then they came to the working expenses, which, like the poor, were always with them. That item amounted to £1,015,442, as compared with £922,692 in the last half-year, an advance of £92,750. The net result was an increase in the business of £37,695. Dealing with the figures on the basis of a year's trading, the income accrued in respect of the business for the year ending December 31st last was £3,422,423, as compared with £3,149,126, an increase of £273,297, and they had paid in Post office royalties £329,494, an advance of £26,510. He might mention that they had paid no less than 3½ millions sterling to the Government under this heading, without receiving any value whatever in return, unless it revealed itself in *Dreadnoughts*, in which shareholders had not an exclusive interest. The net income for the year 1909 was £2,846,141; this year it had gone up to £3,092,928, an increase of £246,782. The total working expenses for the year were £1,987,356, last year they were £1,813,490. The net result in 1910 was an increase of £72,920, bringing the actual figure up to £1,105,572. The rentals carried forward for unexpired periods amounted to £1,413,376, or £88,460 more than last year. He thought the shareholders would see from those figures that the company had progressed notwithstanding the amount of discouragement which it had received. The revenue account for the half-year showed that the rents of premises, rates and taxes, stood at £122,566, an increase of £14,519, which was largely due to the action of local authorities, who were forcing up the rateable value on the assumption that, when the company's licence expired, they would get better terms out of the Postmaster-General. He was sure they wished them luck. The expenses of management, office salaries, &c., were £388,879, an increase of £12,260. That was largely due to the systematic rise in the workmen's wages and the superannuation scheme. They had expended £373,724 on maintenance and renewals of lines and depreciation allowances, which was an advance of £35,118. They had made an increase of over £80,000 for the year on that item, which disproved effectually the statement that the company did not keep the plant up, and that when the Postmaster-General acquired the undertaking it would be an attenuated concern. The ratio of working expenses to the receipts was 64·41, as compared with 63·80. There was a new item called the inventory and arbitration suspense account, which had credited to it £25,000. They had a staff of 450 engaged in making an inventory of the company's possessions, and they would be at work for 15 months. Under an arrangement with the Postmaster-General, the Government also had a staff of some 200 persons, who were checking the company's figures. It was hoped that the result of this work would be to get a satisfactory enumeration of the company's effects in case they should have to go to arbitration when the time came for the transfer of the undertaking. It had been arranged that the expenses of making this inventory should be borne in equal parts by the Government and the company. The balance-sheet showed that they had stock and materials to the value of £240,384, as compared with £314,870, a satisfactory diminution of £74,486. The special replacement account of £43,445 would entirely disappear during the ensuing year, while the total amount of shares held in other companies, cash in bank, and in hand, &c., amounted to £1,055,752. The total assets of the company as shown by the balance-sheet, amounted to £6,378,154, which was met with liabilities on the other side of the account, as follows:—Subscriptions in advance, £1,275,988; sundry credit balances, £892,095; reserve fund account, £3,779,229; leaving a sum of £430,840 for distribution. He had received many letters and communications on the subject of the amount which

the reserve fund had now reached. He would point out to those shareholders who had written to him that the capital account was made up by money spent on purchasing various undertakings and construction of works; whereas the value to be arrived at under the purchase scheme was to be taken on the value of the assets, less allowances for depreciation. The directors had endeavoured by their policy of making transfers to the reserve fund, to be able to meet any ultimate shrinkage that might occur when the undertaking was transferred. It behoved them to walk warily in the distribution of profits, and he did not think anyone would accuse the directors of any lavishness in that respect, but they had to remember that any other policy which the board might have adopted might have met with disastrous results. The company had received notices of objection to purchase a quantity of plant, land and buildings in connection with what were known as competitive stations, and also against the purchase of what were purported to be stations not constructed in accordance with specifications, and which on that ground would be unsuitable for the Government. He need hardly say that the company entirely dissented from such contentions, and it might be a matter which the Railway and Canal Commissioners would have to determine. As regarded saying anything about the coming transfer, he could only state that he wished that the way had been made clearer and smoother. They had to deal with the 1905 agreement, and the facts as they arose, and he thought they would agree that he ought to be if anything rather reticent on the subject.

Mr. S. H. Sands seconded the motion.

A short discussion then took place, which was more or less confined to what would happen when the Postmaster-General took over the concern.

The Chairman, in reply, said that it was only natural with the various classes of shares involved that the shareholders would want to know something as to what would happen at the transfer. But the whole thing depended on what they got. They had taken counsel's opinion as to the terms of the agreement, and that had been circulated among the shareholders. The only thing to be done was to see what they got from the Government. There might arise instances where questions would have to be fought out in the courts, and, as he had said on previous occasions, the company were prepared to afford every facility to the shareholders in such an event. He had seen it stated in the Press that the Government had retained the services of an American expert to deal with the question of value, &c., and, of course, they were entitled to get their advice from where they liked. He only wished the Government would take more expert advice, for such a course must be to the advantage of the company.

The report was adopted.

Waste Heat and Gas Electrical Generating Stations, Ltd.

The directors report that the profits earned during the year ended January 31st, 1911, after deducting administration and other expenses, and the expenses in connection with the increase in the nominal capital of the company, amount to £21,915 (against £16,745). Of this they have transferred to reserve account (making it £13,000), £7,000 (against £4,000 plus £865 written off). To the balance of £14,915 there must be added £3,603 brought forward making a total of £18,518 against £12,523. The directors propose a dividend at the rate of 8 per cent. for the year, which will absorb £12,470 as compared with 7 per cent. absorbing £8,920 in the previous year. Out of this an interim dividend was paid in August, 1910, amounting to £3,813. The balance to be carried forward is £6,048 as compared with £3,603. It is proposed to pay the balance of the dividend on March 15th, 1911, less income-tax. The extensions to the Newport generating station referred to in the last report were completed in September, 1910, and the output from that generating station has now largely increased. The Weardale station has also been running satisfactorily throughout the year, but the equipment at the Tees Bridge generating station has not yet been accepted from the contractors, and payment has consequently not been made in full. The company's investment in the Bankfoot Power Co., Ltd., has yielded a satisfactory return. The generating station at Bankfoot is being enlarged, and the company will, during the course of the coming year, have the option of taking up further capital in the Bankfoot Power Co. Negotiations are proceeding for the erection of further generating stations for the utilisation of exhaust steam, which will in due course require a further issue of capital.

Oxford Electric Co., Ltd.

The directors in their report and accounts for the year ending December 31st, 1910, state that the revenue account shows a profit (including £940 brought forward) of £15,481. After providing £2,014 for debenture and other interest, also writing off £919 on account of hire-purchase installations, the balance available for dividend is £12,548. The directors propose a dividend at the rate of 7½ per cent. per annum, less income-tax, on the ordinary share capital (whereof 3 per cent. was paid in September last), £7,250; dividend at the rate of 5 per cent. per annum on the preference share capital ranking therefor (whereof 2½ per cent. was paid in September last), £1,958; to credit of reserve and renewal of plant account, £2,370; leaving to be carried forward, £970. Reserve and renewal of plant account has been charged with the cost of plant replaced. It is estimated that at December 31st last there was the equivalent of over 123,000 lamps connected to the mains. The lamp and motive power connections have continued to increase satisfactorily. The plant has been maintained in thoroughly efficient order. With the object of effecting further economies, additional machinery has been installed at the generating station. The supply mains of the company have been extended in Botley, Chadlington, Charlbury, Victoria and Woodstock Roads, in Warwick Street, and the Market.

South Metropolitan Electric Light and Power Co., Ltd.

The annual meeting was held on Monday at Winchester House, E.C., Mr. H. St. John Winkworth presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 311), said he thought he might fairly congratulate the shareholders upon the results shown therein, especially if they took into consideration the adverse effect upon the revenue of the great saving consumers were obtaining through the use of the more efficient metal-filament lamp. The lamp connections showed an increase of 16,744. The consumers connected at the end of the year amounted to 4,305, an increase of 389, as compared with 267 for the previous year, and the extensions to existing installations were 320, as compared with 186 for the corresponding period, which was an indication that the light in the company's area was far more popular. This had been largely brought about by the advent of the metal-filament lamp, making electricity not only the best, but the cheapest form of illuminant. The units sold amounted to 4,207,381, as compared with 3,611,839, an improvement of about 16 per cent., which was almost entirely due to the extension of the demand for power. The average price obtained was 2·38d., as against 2·59d. for last year, which was again due to the larger proportion of units sold for power purposes. The revenue from the sale of electricity showed an improvement of £2,639. The total receipts amounted to £44,607, or £2,840 more than last year. Dealing with expenditure, they had spent £392 more on coal, and when it was borne in mind that their sales had increased by nearly 600,000 units, he thought the small increase in their coal bill afforded satisfactory evidence of the efficient working of their new power house. The total generation and distribution costs showing an increase of £730. The total expenditure amounted to £17,678, and represented 40 per cent. of the gross revenue, practically the same as last year. The cost per unit sold amounted to 1·01d., as compared with 1·09d. for the corresponding period, a decrease of nearly 8 per cent. The net receipts were £27,009, and represented a return of 4·91 per cent. on the average capital expenditure, as compared with 4·75 per cent. for the previous year. The total charges for interest on debenture stock and other interest amounted to £11,065, leaving £17,050, which would provide for interest on the first and second preference shares, leaving a balance of £4,043, out of which the directors proposed to place £2,000 to depreciation fund, to write off the balance of the Crystal Palace account of £800, carrying forward a balance of £1,242. The capital expenditure during the year amounted to £18,748, of which about £10,000 was for new mains, service lines, meters, &c., and of the balance about £6,000 had been expended on the extension of the extra-high-pressure trunk mains to Catford, including the necessary transformers, switchboards, &c. The total cost of this work would be about £9,000, of which about £3,000 was payable during the next few months. This work had increased the capacity of the cables threefold, and had enabled them to deal with the rapidly increasing business at Lewisham, which was now becoming an important shopping centre. Of the remainder, about £2,500 had been expended on the purchase of the installations of the National Electric Free Wiring Co. in the Sydenham area, which they took over with the purchase of the Crystal Palace and District Electric Co.'s undertaking. In order to develop the more general use of electricity for heating, cooking, ventilating and power for trade and domestic purposes, the company had opened extensive showrooms at their premises in High Street, Lewisham. In accordance with the agreement mentioned in the last report, the company has subscribed for 10,000 shares of £1 each in the West Kent Co., of which 10s. per share had been called up, and out of the proceeds of this issue the item of £2,540 figuring in the last balance-sheet as a debit against the West Kent Co. had been repaid. Mains had been laid to Mottingham, and consumers were now being supplied there under their bulk supply agreement. The West Kent Co. had also purchased certain mains laid by agreement with the Bromley (Kent) Electric Co. in the Hayes district, and was taking a supply from that company on terms which would yield a fair return upon the capital employed. As the company only commenced to give a supply during the last few months of the year, the revenue received was quite small, but negotiations were taking place for the lighting of certain buildings, the supply of power, and also for a bulk supply to certain authorised undertakers, and the West Kent Co. would eventually be able to build up a good business. Last year he was able to state that they appeared to have overtaken the loss of revenue through the use of metal-filament lamps so far as their sales to shopkeepers were concerned, and he was pleased to be able to report that there had been a fair increase in their sales to shopkeepers during the year, and the reduction in sales to private house consumers had, with the aid of new business and the extension of existing installations, been largely overtaken. Indeed, owing to increased sales for other business purposes, the units sold for lighting were a little more than last year. Although it was calculated that the metal-filament lamp had adversely affected the company's revenue by approximately £12,000 to £15,000 during the last three years, there was little doubt that the greatest effect had now been felt, and there was every indication that the company's revenue

from lighting was again on the upward grade. The great advance in the efficiency of electric lighting was causing consumers to make a greater use of the supply; the number of lamps installed per consumer was growing, and the old principle of installing the electric light in the best rooms only was losing ground. One of the difficulties in obtaining orders from would-be consumers where economy was the chief consideration, was the present high cost of the metal-filament lamp, and another difficulty was the cost of installing the wires. He was pleased to say it was now becoming the custom for builders in the area to wire new properties, and in many cases owners of the older houses were also willing to pay the cost of putting in the necessary wires, or to pay the company a rental for the same during the occupancy of their tenants. The company was considering a scheme of maintenance for overcoming the obstacle of the initial cost of the metal-filament lamp, the life of which had been proved under normal conditions to be about 2,000 hours. Two or three large installations had recently been connected, and the company had received a special order from the Council of the Festival of Empire for lighting part of this important Exhibition at the Crystal Palace this year, and they had also requested the company to undertake the laying of the necessary cables required for the Exhibition in the Palace grounds. New orders and extension orders were coming in very well, and although it was unwise to prophesy, there was every indication that they might expect an increased revenue, both from light and power, during the present year, and he hoped that when they met again next year he would be able to lay before them accounts which would show steady progress in the improvement of their position.

Mr. H. W. Bowden, M.I.C.E., in seconding the resolution, gave particulars of the high-tension transmission lines which the company had put down between Blackwall and Catford, and said that up to the present time the installation had proved in every way satisfactory.

A short discussion ensued, in which one or two shareholders expressed dissatisfaction at the progress the company was making, and inquired when the ordinary shareholders might expect a dividend.

The Chairman, in the course of his reply, remarked that the directors between them held about one-half of the ordinary shares, and it would therefore be apparent that no one was more disappointed than they were at not being able to pay a dividend. The company had had seven years of adversity. It was the last company to be established in London, and just as it was beginning to get on to a satisfactory basis the big fight began in Parliament, and that lasted four years, and involved the expenditure of over a million and a half of money in defending the rights of the companies. Then they had the introduction of metallic-filament lamps to contend against, and when they considered that that had affected their revenue to the extent of between £12,000 and £15,000 during the last three years, he thought they ought to feel some measure of satisfaction that they had been able to get back to their revenue of three years ago. He was looking forward with confidence to an improved condition of affairs. He really believed the company had turned the corner, but the ordinary shareholders would have to exercise patience. As to increasing the capital, of course a business of that kind could never stand still—all they could do was to see to it that no fresh capital expenditure was embarked upon which did not promise to yield a satisfactory return.

The report was then adopted.

Notting Hill Electric Lighting Co., Ltd.

The directors' report for 1910 states that the expenditure on capital account has been increased by £1,880, and it now stands at £243,332, and exceeds the receipts by £35,332. The cost of the joint station to date has amounted to £224,213, and joint debenture stock amounting to £227,500 has been issued. This stock is subject to a cumulative sinking fund, which now amounts to £40,487, invested in trustee securities. The progress of the company has been as below:—

	Equivalent of 8-c.p. lamps connected.	Profit.
1907	160,849	£19,057
1908	168,885	19,484
1909	180,903	20,8·9
1910	189,885	22,002

The number of consumers is now 3,253, and with the exception of 34 they are supplied at 200 volts. The gross revenue for the year was £41,031, an increase of £1,152, and the total net profit was £22,002. To depreciation, renewal and reserve fund there has been put £3,000; debenture and other interest requires £2,447; Kensington and Notting Hill joint debenture stock, interest £2,291, sinking fund £1,359; leaving a balance available for dividend of £12,905.

The directors recommend the usual dividend of 6 per cent., and a bonus of 2 per cent. for the year to the preference shareholders; the usual dividend of 6 per cent., and a bonus of 2 per cent. for the year to the ordinary shareholders; and a distribution of £5 per share to the founders' shareholders.

The directors, having arrived at the conclusion that it is advisable to rearrange the capital of the company, formulated a scheme to carry this into effect without disturbing the respective rights of the various classes of shareholders. After consulting and obtaining the approval of the majority of each class of shareholders, they applied to the High Court for permission to carry out the scheme, and by its order the necessary resolutions and consequent alterations in the articles of association are to be submitted to the various classes of shareholders at meetings to be held on the same day as, but prior to, the annual general meeting. If approved, they will be submitted to the High Court for confirmation before being put into effect. The scheme requires the issue to the shareholders of 27,050 new ordinary shares to represent their interests in the profits after 6 per cent. has been paid and in the surplus assets. As the issue of such shares without payment cannot be made legally, the directors have fixed the value at the nominal figure of 1s. This is covered by the increase of the dividend of this year over last, and to meet the convenience of shareholders can be deducted from the dividend warrants. The London Electric Supply Bill, introduced again during the year by the Board of Trade, has been passed by Parliament, and enables the London County Council to purchase the company's undertaking.

Units generated and purchased	3,104,577
Units sold—Public lamps	104,162
Private consumers by meter	2,093,558
Total sold	2,197,720
Units used on works	25,742
Total accounted for	2,224,462
Expended in distribution transformers and accumulators	880,115
Public lamps	53
Total max. supply demanded, kw.	1,590

Chelsea Electricity Supply Co., Ltd.

The directors report that the profit for the year 1910 amounts to £36,567, which, with £1,363 brought forward and £968 for interest, makes a total of £38,897. After deducting interest on debenture stock £7,875, interim dividend 6 per cent. on preference shares £900, interim dividend on ordinary shares at the rate of 4 per cent. per annum £4,944, there remains a balance of £25,179, which the directors recommend shall be appropriated as follows:—To credit of renewals and depreciation fund, £12,772; to credit of debenture stock premium redemption fund, £704; to amount written off cost of extinction of founders' shares, £1,089; to final dividend on the preference shares at the rate of 6 per cent. per annum, making 6 per cent. for the year, £900; to final dividend on the ordinary shares at the rate of 6 per cent per annum, making 5 per cent. for the year, £7,415; leaving to be carried forward, £2,298. The number of 8-c.p. lamp equivalents connected on December 31st, 1910, was 272,087, an addition of 10,957 during the year; and the total number of units sold was 4,144,936, being 338,570 more than the previous year.

Prospectuses.—*Water Softeners, Ltd.*—This company has been offering for subscription an issue of 60,000 £1 shares at par. It is formed to acquire and combine under one control and management the British rights of the "Luminator" and "Permutit" processes for the removal of hardness from boiler feed and other waters. The nominal capital is £200,000, and the purchase price is £155,000, payable as to £35,000 in cash and £120,000 in shares. After paying preliminary and underwriting expenses there will be £17,000 for working capital and 20,000 shares will be held in reserve. The company will acquire the existing organisation whereby the manufacture of the "Luminator" is at present proceeding with two well-known engineering firms. Arrangements are being made for the company to install its own factory for the manufacture of the actual "Permutit." The list was to close yesterday.

Rio de Janeiro Tramway, Light and Power Co., Ltd.—The list is to close to-day in an offer of £600,000 5 per cent. 50-year mortgage bonds at 95 per cent.

Companies Struck Off the Register.—The following companies have been struck off the Register, and are accordingly dissolved:—

Accessible Battery and Engineering Co., Ltd.
Ashford and District Electric Supply Co., Ltd.
Automatic Circuit Breakers, Ltd.
Automatic Smokeless Furnace Co., Ltd.
Automixte, Ltd.
Bastian Mercury Vapour Lamp Co., Ltd.
British Accumulator Co., Ltd.
British Arc Lamps, Ltd.
Camberley Electric Supply Co., Ltd.
Chinnery's Advertising Signs, Ltd.
Crawford Electric Lamp Syndicate, Ltd.
Ekstromer Accumulator Co., Ltd.
Electrical Mining Co., Ltd.
Electric Loco-Motor Propulsion Co., Ltd.
Evaporator and Smoke Condenser Co., Ltd.
Explosive Turbine Syndicate, Ltd.
Farnham and District Electric Supply Co., Ltd.
Glover's Water-Tube Boiler Co., Ltd.
Gould Storage Battery Co., Ltd.
Hay Boiler and Engineering Co., Ltd.
International Association of Technical Experts, Ltd.
Lens Lamp Co., Ltd.
Mercedes Petrol Electric Co., Ltd.
Modern Traffic Development Corporation, Ltd.
New Process Wire Drawing Syndicate, Ltd.
Nottingham Electrical Co., Ltd.
Phillips Railway Signalling Syndicate (1907), Ltd.
Red Cross Light Cure Institute, Ltd.
Simplex Gas Engine Starter, Ltd.
Traction Corporation, Ltd.
Universal Insulator Co., Ltd.
Wave Power Co., Ltd.

W. T. Henley's Telegraph Works Co., Ltd.—The directors have recommended a dividend on the ordinary shares at the rate of 15 per cent., free of income-tax, including the interim dividend of 5 per cent. paid September 1st last. For 1909 the total dividend was at the same rate.

MARKET QUOTATIONS.

Wednesday, March 1st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	„	28/-	..
a „ Sulphuric	„	5/6	..
a Ammoniac, Sal	„	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	..
a „ „	„	£30	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon (50 %)	„	£12 10	£3 inc.
a Copper Sulphate	„	£21	..
a Lead, Nitrate	„	£25	..
a „ White Sugar	„	£22 15	..
a „ Peroxide	„	£89	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a „ Chlorate	per lb.	8½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide	„	7d.	..
a Shellac	per cwt.	80/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70 %) ..	„	£11	..
a „ Chlorate	per lb.	8½d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	8d.	..
a „ Cyanide (basis 100 %) ..	„	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£75	..
b „ Wire, in ton lots ..	„	£102	..
b „ Sheet, in ton lots ..	„	£120	..
p Babbitt's metal ingots	„	£88 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	6½d.	..
c „ Tube (brazed)	„	8½d.	..
c „ „ (solid drawn) ..	„	6½d.	..
c „ Wire, basis	„	6½d.	..
c Copper Tubes (brazed)	„	8½d.	..
c „ „ (solid drawn ..	„	8½d.	..
g „ Bars (best selected) ..	per ton	£70	..
g „ Sheet	„	£70	..
g „ Rod	„	£70	..
e „ (Electrolytic) Bars ..	„	£67 15	..
e „ „ Sheets ..	„	£73 10	..
e „ „ Rod ..	„	£61 10	10/- dec.
c „ „ H.C. Wire	per lb.	7⅞d.	1/32d. inc.
f Ebonite Rod	„	6/-	..
f „ Sheet	„	5/6	..
n German Silver Wire	„	1/11	..
b Gutta-percha, fine..	„	8/6	..
h India-rubber, Para fine	„	7/-	9d. inc.
i Iron Pig (Cleveland warrants) ..	per ton	48/8	4½d. dec.
i „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Ingot	„	£13 10 to £13 15	7/6 inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£10	£1 10 inc.
d Mica (in original cases) small ..	per lb.	6d. to 1s.	..
d „ „ „ medium	„	2/6 to 4/-	..
d „ „ „ large ..	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	11d.	..
p „ „ rolled bars & rods	„	1/0½	..
p „ „ rolled strip & sheet	„	1/1	..
o Platinum	per oz.	166/6	6/6 inc.
e Silicium Bronze Wire	per lb.	8½d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£188 to £190	ir e.
n „ Wire, Nos. 1 to 16	per lb.	2/2	..
p White Anti-friction Metals ..	per ton	£45 to £150	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	£28 15	£1 dec.

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

A Swiss Telephone Undertaking.—The general meeting of the Zurcher Telephon Gesellschaft, of Zurich, has resolved to accept an offer made by an Italian syndicate to take over the shares in the former at the price of 125 lire per share, this being the present nominal value. The directors recommended the sale of the shares, as the company's concession expires in 1917, and it is uncertain whether it will be renewed. No dividend has been paid on the telephone company's shares for a number of years past, and the telephone network construction account still to be written off stood in the balance-sheet for 1909 at slightly over £40,000.

London Electric Wire and Smiths, Ltd.—The annual meeting of the shareholders of the above company was convened for Wednesday last week, at the offices, 7, Playhouse Yard, Whitecross Street, E.C. A representative of the ELECTRICAL REVIEW, who attended to report the proceedings, was informed that the meeting was quite private.

STOCKS AND SHARES.

Tuesday Evening.

LAST week we concluded this letter with the innocent remark that the market in rubber shares "verges towards stagnation." Much virtue lay in the word "verges," for on a sudden the rubber department woke up like a giant refreshed, and in a whirl of tempestuous buying such as recalled the boom of last spring, prices flared up at rocket-rate. In the excitement of the movement other industrials perforce took a seat far back, and only the purely investment departments are busy, their strength being sustained by a good rise in the price of Goschens.

Electricity Supply shares quietly improve, and the dividends and reports of the past week have had a favourable effect upon the market. Apart from this, however, the expected *rapprochement* between the London and North-Western Railway and the Metropolitan Electric Supply Company has certainly helped to divert more general attention to the great possibilities that open out in the direction indicated here last week; that is, through the strong likelihood of other railway companies following upon the lines so successfully initiated in the South by the London and Brighton electrifying part of its suburban system.

To particularise, there are advances in Brompton Ordinary and Preference, Charing Cross Ordinary and City Undertaking Preference, Notting Hill, Urban Preference, County Ordinary and both Debenture stocks, Kensington Ordinary and Metropolitan Preference. St. James' and London Electrics are *ex* dividend, and the declines in their prices represent practically the amount of the distributions.

Edmundson's have risen more than any of the others, in proportion to their size, the Ordinary being put up to 10s. middle, the Preference gaining 5s., and the Debenture stock being 3 points up at 83½. Brush 4½ per cent. First Debenture, however, has done better still, rising 5 in addition to recovering 2½ for the interest which the stock was quoted *ex* last Friday. The company's Second Debenture put on 2, and the Preference shares hardened slightly. The advance in the First Debenture is equal to 12¼ in a fortnight, or about 33 per cent. of the value at the price from which it started.

City and South London Ordinary rose ½ further, and Metropolitan Consolidated has been singled out for especial favour, gaining 2¼ points, while the Surplus Lands put on 2. Districts advanced, and Underground Electric 4½ per cent. bonds went up 2. The Fives are lower at 102 on the proposal to pay them off.

Latin-Canadians are rather a "patchy" market, the movements being of a see-saw sort. Rio Trams are lower at 110, but Mexico Tramway shares have hardened a trifle. Mexican Light and Power Common and Preferred shares eased off, yet the 5 per cent. bonds have been advanced a point.

Much more interesting is the market in other Tramway and Traction issues, amongst which London United Preference present the outstanding feature with a jump of 25s. to 3¼, business being marked at 3 7/16 on Monday. The Debenture stock rose 3, and the improvements are pleasant compliments to the new manager, besides being sympathetic with the rise in London General Omnibus stock. Potteries are quoted higher, both as regards the Ordinary and Preference, while British Electric Tractions hardened up to 2 middle, after being ½ higher. Auckland Electric Trams 5 per cent. first Mortgage Debenture stock has been attracting buyers, who put up the price by 1½, and Anglo-Argentine Tramways second Preference have improved a little.

In the telegraph and telephone market, chief interest continues to centre in National Telephone stocks. The Deferred and Preferred are both *ex* dividend, and the former shows a fall of about three points, allowing for the deduction. In such cases as these, where the uncertainty surrounding the situation is to be settled within a reasonable time, the market tendency is to take a very optimistic view, and it is quite easy to work out estimates showing that the stock will be paid off at anything from 150 to 175 per cent. The great uncertainty, however, must necessarily lie in the question of what depreciation the arbitrators will take off from the assets as set out by the company, and on this point, of course, it is impossible to say anything definitely. Both Preference stocks are down 5s., the dividends in their cases being 6s. each.

Telegraph stocks are somewhat overclouded by the rush in the rubber market, and the tendency has been to make prices rather lower. Business, however, has come to something of a standstill, so the changes are rather slight. The Mackay Companies have raised their dividend on the Ordinary stock to 5 per cent. again without affecting the quotation. Other trust shares are steady, but there is nothing much doing in them. Anglo-American Telegraph issues have spurted, and Amazons hardened to 6 middle.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1907.	1908.	1909.	1910.	Closing Quotations Feb. 21st.	Closing Quotations Feb. 28th.	Business done week ended Feb. 28th, 1911. Highest	Lowest.	Rise + or Fall —	Present Yield per cent £ s. d.
800,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	5⅜ — 6⅛	5⅜ — 6⅛	..	..	+ ⅛	Nil.
$263,244,000	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96 — 98	96 — 98	97	..	..	5 2 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	..	149 —151	148 —150	..	..	—1	5 6 8
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
545,920	Anglo-American Telegraph	Stock	3½%	£3 4s.	3⅝%	3⅞%	67½— 69½	68 — 70	..	..	+ ½	5 7 2
3,227,040	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	111 —112	111½—112½	112	110½	+ ½	5 6 8
3,227,040	Do. do. do. Deferred	Stock	1 %	8/-	25/-	30/-	26½— 26⅝	26⅞— 27⅛	27	25 13/16	+ 1/16	5 10 1
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7 — 7½	7 3/16 — 7 5/16	7 3/16	7 1/16	+1/16	5 9 5
2,462,309	Commercial Cable, Stlng. 500 year 4% Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	87⅛	87	..	4 10 11
16,000	Cuba Telegraph	10	6 %	6 %	6 %	..	9 — 9⅛	9 — 9⅛	9 1/16	..	..	6 3 1
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	17 — 18	17 — 18	..	..	..	5 11 1
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅞— 4	3⅞— 4	..	..	..	5 0 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10%	8½— 9	8⅞— 9	8 11/16	..	+ ⅛	5 11 1
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99½—101½	99½—101½	..	..	..	4 8 8
60,710	Direct United States Cable	10	4½%	4½%	4 %	5 %	7⅞— 8	7⅞— 8	7⅞	7 11/16	..	6 4 3
32,500	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	135 —138	134 —137	136½	135½	—1	5 2 2
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	84 — 86	85½— 85½	85¼	84½	— ⅛	4 1 10
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	100½—102½	101 —103	101¼	..	+ ⅛	3 17 8
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13¾— 13⅞	13⅞— 13⅞	13⅞	13⅞	— ⅛	5 2 9
752,400	Do. 4 % Deb. Stock..	Stock	4 %	4 %	4 %	4 %	99 —101	99½—101½	..	..	+ ½	3 18 10
200,000	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100½—102½	100½—102½	..	..	..	3 18 1
181,127	Globe Telegraph and Trust	10	5⅛%	5⅛%	5⅛%	..	10⅜— 10⅞	10⅝— 11	10⅝	..	+ ⅛	5 4 4
181,127	Do. do. 6 % Pref..	10	6 %	6 %	6 %	..	13⅛— 13⅝	13 — 13½	13 7/16	13 3/16	— ⅛	4 8 11
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	18 %	18 %	..	32 — 33	32½— 33½	32⅝	..	+ ¼	5 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	56 — 58	56½— 58½	58	..	..	5 11 1
$41,380,400	Mackay Companies Common	$100	4 %	4 %	4½%	5 %	94 — 97	94 — 97	..	..	..	4 7 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	77 — 79	77 — 79	..	..	..	5 1 3
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	1/16— 1/16	1/16— 1/16	18/-	16/6	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	1 — 1	1 — 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	31/32— 1	31/32— 1	..	..	..	5 11 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107 —108	104 —105 xd	107⅜	104	..	5 14 3
3,725,000	Do. do. Def. Stock	100	6 %	6 %	6 %	6 %	143 —145	138 —140 xd	145⅛	137½	..	4 5 9
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10½— 11	10 — 10⅜ xd	..	..	..	5 11 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅜— 11⅛	10⅜— 11 xd	10⅝	..	..	5 9 1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	6⅛— 6⅜	6 — 6⅛ xd	6⅛	6 3/16	..	4 0 0
2,200,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	..	..	..	3 10 0
1,983,598	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	98⅝—100⅛	98⅛—100⅛	99	..	..	3 19 7
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	8 %	8 %	8 %	..	1⅝— 1⅞	1⅝— 1⅞	3/4-	..	..	4 11 5
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	87 — 89	87 — 89	..	..	..	4 9 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	97½— 99½	98 —100	98	..	+ ½	4 0 0
11,839	Reuter's	8	5 %	5 %	5 %	..	7⅞— 8	7⅞— 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	96⅜— 98⅜	96⅜— 98⅜	..	..	..	4 11 5
2,992	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	133 —136	133 —136	..	..	..	4 8 3
150,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7¼— 7½	7⅛— 7⅜	7 3/16	7 1/16	+ ⅛	5 1 7
40,000	Do. 5% Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	4 7 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1¼— 1½	1¼ — 1½	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97½— 99½	97½— 99½	..	..	..	4 0 5
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13⅜— 14⅛	13⅜— 14⅛	13 13/16	13⅜	..	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99½—101½	100 —102	..	..	+ ½	3 18 5
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	2¼— 2⅜	2¼— 2⅜	45/-	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10½	10 — 10½	10⅜	..	..	5 14 3
4,669	Do. do. 6 % Cum. 2nd Pref.	10	£2 6	15 %	14½%	..	8⅞— 9¼	8⅞— 9⅜	..	..	+ ⅛	6 8 0
80,000	Do. do. 5 % Debs., Nos. 1 to 800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	5 %	..	4⅞— 5⅛	4⅞ — 5⅛	5 1/16	5 1/32	..	4 17 7
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	5 %	..	4 29/32— 4 31/32	4⅞ — 4⅞	95/7½	..	+ 1/16	5 2 7
4,465,674	Do. 4 % Deb. Stock	Stock	..	4 %	4 %	4 %	92 — 93½	94 — 93½	92¼	92¼	..	4 5 7
329,002	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	102½—104½	104 —106	.	..	+1½	4 14 4
830,000	Babcock & Wilcox, 1 to 830,000	1	20 %	20 %	24 %	..	5⅛— 6⅛	5⅛— 6⅛	6 1/32	..	..	4 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1⅜— 1⅝	1⅜— 1⅝	..	..	..	4 0 0
600,000	British Columbia E. Rail Def. Ord. Stock ..	100	8 %	8 %	8 %	..	145½—148½	146 —149	147⅞	147	+ ⅛	5 7 5
600,000	Do. Pref. Ord. Stock	100	5 %	6 %	6 %	..	125½—128½	125½—128½	127⅛	125½	..	4 8 6
600,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	109½—112½	109 —112	110½	109⅛	— ⅛	4 9 3
230,800	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
210,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	..	1 15/16— 2 3/16	1⅞ — 2⅛	47/6	40/-	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	3 %	1¼%	Nil	..	4⅛— 5	4⅛— 5 1/16	101/3	95/-	+ 1/16	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	9⅛ — 98	95 — 99	98	96½	+1½	5 1 0
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	75 — 80	77 — 82	78	76½	+2	5 9 9
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	..	7 — 7½	7 — 7½	..	..	..	6 13 4
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅜— 6⅛	5⅜— 6⅛	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
201,579	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	96 — 99 xd	..	..	..	4 10 11
500,000	British Westinghouse 10 % Pref., 1 to 200,000 and 275,001 to 575,000 Non cum.	5	Nil	Nil	Nil	..	⅜ — ⅝	⅜— ⅝	10/6	..	..	Nil
1,341,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	55 — 58	59 — 62	59¾	58½	+4	6 9 1
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/8	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,838	Brush Electrical Engineering, Ord., 1 to 140,838 ..	2	Nil	Nil	Nil	..	1/4— 5/16	1/4— 5/16	..	..	..	Nil
199,835	Do. do. Non-cum. 7 % Pref... ..	2	Nil	Nil	Nil	..	3/16— 1/4	3/16— 1/4	5/6	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	45 — 50	50 — 55	53	..	+5	8 3 8
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	33 — 38	35 — 40	38½	..	+2	11 5 0
137,610	Calcutta Trams, 1 to 137,610	5	6 %	4½%	4½%	..	5⅛— 5⅜	5⅛— 5⅜	5 1/16	5 1/16	..	4 0 0
47,295	Do. 5 % Cum. Pref., 1 to 47,295 ..	5	5 %	5 %	5 %	..	4⅞— 5⅛	4⅞— 5⅛	..	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	97 —100	..	..	..	4 10 0
85,000	Callender's Cable Construction shares	5	15 %	15 %	10 %	..	9⅛— 9⅜	9⅛— 9⅜	..	..	..	5 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4⅞— 5	4⅞— 5	..	..	..	4 18 0
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/8	10/9	10/3	—1/32	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	12 %	12½%	17½%	..	3 1/16— 3 3/16	3 1/16— 3 3/16	65/7½	63/9	..	5 6 1
205,369	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4½%	4½%	104 —106	104 —106	..	..	..	4 4 11
1,854,740	Central London Railway, Ord. Stock	Stock	3 %	3½%	3 %	3 %	68 — 70	68 — 70	69½	68½	..	4 5 9
572,640	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	84 — 86	84 — 86	85½	85	..	4 13 0
572,640	Do. do. Def. do.	Stock	2 %	2½%	2 %	2 %	49 — 51	49 — 51	50⅜	..	..	3 18 5
1,480,000	City and South London Railway	Stock	2½%	1¼%	1½%	1½%	29 — 30	29½— 30½	31	29½	+ ⅛	4 18 4
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..	Nil
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 1,100 of £50 Red	..	5 %	5 %	5 %	5 %	70 — 80	70 — 80	..	..	..	5 0 5

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Feb. 21st.	Closing Quotations Feb. 28th.	Business done week ended Feb. 28th, 1911.		Rise + or Fall —	Present Yield per cent.
		*	1907.	1908.	1909.	1910.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	6 %	5 %	..	1⅜ — 1 1/16	1⅜ — 1 1/16	..	..	..	4 14 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1⅛	1 — 1⅛	..	..	..	5 6 8
265,480	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 10 7
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	Nil	Nil	..	⅜ — 7/16	⅜ — ⅜	13/-	11/-	— 1/16	Nil
17,189	Do. "A" shares, 01—017,189	5	2½%	Nil	Nil	..	1½ — 2½	1½ — 2½	41/10½	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 67	63 — 67	..	..	..	5 19 5
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	78 — 81	78 — 81	..	..	..	6 3 5
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	⅜ — 1	⅜ — 1	..	..	..	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	..	1⅛ — 2 1/16	1⅛ — 2 1/16	..	..	..	7 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	85 — 90	85 — 90	..	..	..	4 8 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	⅛%	Nil	Nil	..	⅜ — 1	⅜ — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ — 10⅝	10½ — 10⅝	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103¼	102 —103¼	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12½ — 13	12½ — 13	..	..	..	5 15 5
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5½	4⅞ — 5⅞ xd	..	..	..	4 7 10
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..	4 5 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	..	15⅝ — 16½	15⅝ — 16½	..	..	..	6 1 8
87,500	†Liverpool Overhead Railway, Ord.	10	⅛%	Nil	Nil	1½%	11⅛ — 1 13/16	2⅛ — 2 1/16	..	..	+ 1/16	5 9 1
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	7 — 7⅛	7⅛ — 7⅞	..	..	+ ⅛	6 9 0
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	Nil	Nil	Nil	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	Nil
899,930	Do. do. 60,008 to 100,000	10	3 %	Nil	Nil	Nil	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	3⅛%	Nil	Nil	2 — 2⅛	3 — 3⅛	68/9	57/6	+1	..
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	71 — 75	74 — 78	76	..	+ 3	5 2 7
5,782,062	Metropolitan Consolidated	100	⅛%	4%	1	1⅛%	43½ — 44	45⅞ — 46⅛	46 5/8	45	+ 2⅛	2 8 7
2,640,914	Do. Surplus Lands	100	2⅛%	2⅛%	2⅛%	2⅛%	63 — 65	65 — 67	65⅛	64⅛	+ 2	4 1 2
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	26 — 26½	26⅞ — 27⅛	27 3/16	26⅛	+ 1/16	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	4½%	5%	..	1⅜ — 1 1/16	1⅜ — 1 1/16	20/-	..	..	4 14 1
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	⅞ — 1	15/16 — 1 1/16	17/6	..	— 1/16	5 3 11
589,183	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	..	100 —102	101 —103	103	102	+1	4 7 5
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	6 %	..	127⅞ —128⅝	128 —129	129⅛	128⅞	+ ⅛	4 13 0
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	5 %	5 %	..	99⅝ —100⅜	100 —101	100⅜	100	+ ⅛	4 19 0
245,000	Potteries Electric Traction	1	4 %	Nil	2 %	..	7/16 — 7/16	7/16 — 7/16	7/8	6/-	+ 1/32	4 4 3
245,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	13/32 — 7/16	13/32 — 7/16	13/9	12/3	+ 1/32	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
87,350	Telegraph Construction and Maintenance	12	17½%	15 %	17½%	20 %	39 — 41	39 — 41	40	..	..	5 17 8
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1919	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	5 %	5 %	..	102½—103½	101½—102½	103⅛	101⅞	—1	4 17 7
2,818,700	Do. do. 4½ % Bonds	..	..	4½%	4½%	..	95 — 97	97 — 99	98⅝	96½	+2	4 10 11
4,928,050	Do. do. 6 % Income Bonds	..	..	..	..	1 %	44 — 46	46 — 48	47½	45⅛	+2	2 1 8
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	10 %	5 %	Nil	..	⅜ — ½	⅜ — ½	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	6 %	3 %	..	1 — 1⅛	1 — 1⅛	..	..	..	10 0 0
215,769	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 80,449	5	10 %	10 %	10 %	..	7½ — 7⅝	7⅝ — 7¾	7⅝	7⅝	+ ⅛	6 7 0
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7½ — 7⅝	7¾ — 7⅞	..	..	+ ⅛	4 18 11
402,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —103	99 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	..	4 — 4½	4⅛ — 4⅜	92/6	84/9	+ ⅛	5 15 9
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4½ — 4⅝	4⅝ — 4⅞	86/10½	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	3⅞ — 4⅛	3⅞ — 4⅛	81/8	..	..	5 2 10
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 97	96 — 97	..	..	..	4 2 6
43,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	5 %	4½ — 4⅝	4½ — 4⅝	..	..	..	5 8 1
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	7 %	7 %	11⅞ — 12½	11⅞ — 12½	12⅛	12	..	5 14 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	13	..	..	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	119 —123	119 —123	120½	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99 —102	100 —103	102	..	+1	4 7 5
50,000	County of Durham Electrical Power, Ord.	5	2 %	Nil	Nil	..	1⅝ — 2	1⅝ — 2	..	..	..	Nil
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	..	2⅝ — 3⅛	2⅝ — 3⅛	..	..	..	7 16 10
230,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	5 %	5 %	5 %	92 — 94	92 — 94	..	..	..	5 6 5
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅞ — 8½	7⅞ — 8⅝	8 1/16	8	+ ⅛	5 19 5
55,000	Do. do. 6 % Pref., 40,001—80,000 and 120,001—135,000	10	6 %	6 %	6 %	6 %	10⅜ — 11½	10⅜ — 11½	11⅛	10⅝	..	5 6 8
450,000†	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	105 —108	106 —109	108	..	+1	4 2 7
450,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	99 —102	..	..	+1	4 8 3
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	1/16 — 3/32	3/32 — 5/32	9/-	..	+ 1/32	Nil
80,000	Do. do. 6 % Cum. Pref.	5	Nil	Nil	Nil	..	1⅛ — 2⅛	1⅛ — 2⅛	40/-	..	+ ⅛	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	79 — 82	81 — 85	83½	82½	+2½	5 5 11
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	5 %	5 %	..	83½ — 85½	83½ — 85½	83¾	..	..	5 17 0
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 11 11
94,350	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	8½%	8½%	8½%	9 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 19 4
$1,526,500	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	5 %	5 %	..	101 —103	101 —103	..	..	..	4 17 1
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	8 %	8 %	9 %	6⅞ — 7⅛	7 — 7⅛	6 15/16	..	+ ⅛	6 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
111,000	London Electric Supply Corporation, Limited, Ord.	3	2½%	3 %	2 %	2 %	1⅝ — 2	1 11/16 — 1 13/16 xd	..	..	..	3 3 6
90,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 5⅛	4⅛ — 5⅛ xd	..	..	..	5 17 1
387,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
200,000	Metropolitan Electric Supply, 100,001 to 800,000	5	6½%	5 %	5 %	..	4⅛ — 4⅜	4⅛ — 4⅜	92/6	91/10½	..	5 5 3
76,121	Do. 4½ % Cum. Pref. 1—76,121	5	4½%	4½%	4½%	..	4¼ — 4½	4 5/16 — 4 7/16	..	..	+ 1/16	4 18 8
250,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	83 — 86	83 — 86	..	..	..	4 1 5
$5,929,600	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	90½ — 91½	90½ — 91½	91⅜	..	..	5 9 3
$13,585,000	Do. Light and Power Co., Ltd., Common	$100	4 %	3½%	4 %	..	93 — 94	92½ — 93½	93⅜	93¼	— ⅛	4 5 7
$5,400,000	Do. do. 7% Cum. Pref. Stck.	Stock	..	7 %	7 %	..	112½—113½	112 —113	113¾	112¼	— ⅜	6 3 11
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	5 %	5 %	5 %	95½ — 96½	96½ — 97⅛	97⅛	96	+1	5 2 7
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 98	96½ — 97⅛	..	..	..	4 11 10
130,491	Newcastle-on-Tyne, 1 to 50,000 & 57,010 to 187,500	5	8 %	2½%	4 %	..	3⅝ — 4¼	3⅝ — 4¼	..	..	..	2 12 9
187,500	Do. 5% Pref., 1 to 187,500 Non. Cum.	5	5 %	5 %	5 %	..	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 17 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	5 %	..	97½ — 99½	97½ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7 %	7½%	8 %	11⅛ — 12⅜	12 — 12⅝	12	..	+ ⅛	6 5 6
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6¼ — 6⅝	6¼ — 6⅝	..	..	..	5 8 8
120,000	River Plate Elcty. Co. Ord.	Stock	6 %	8 %	9 %	..	225 —235	225 —235	..	..	..	3 16 6
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	..	108 —113	108 —113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 3
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10%	8⅝ — 9	8⅝ — 8⅞ xd	8⅞	8 21/32	..	5 14 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅝ — 7⅛	6⅝ — 7¼ xd	..	..	..	4 16 7
150,000†	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	Nil	1⅝ — 2	1⅝ — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	4 %	5 %	5 %	5 %	3 — 3⅜	3 — 3⅜	..	..	..	5 19 5
100,000	Do. do. 5 % 1st Mort. Deb.	100	..	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 3
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	Nil	Nil	⅜ — ½	⅜ — ½	..	..	..	Nil
142,988	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	+ 1/32	6 8 9
240,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	⅜ — ½	⅜ — ½	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..	+ ⅛	10 10 6
271,700	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	80 — 84	80 — 84	..	..	..	5 7 2
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	5 %	..	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	81/8	..	+ 1/32	5 6 8
110,000	Westminster Electric Supply, Ord.	5	10 %	10 %	10 %	10%	8½ — 8⅝	8½ — 8⅝	8⅝	8½	— ⅛	6 8 1
81,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5	..	..	4 3 9

*. Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 3½ per cent. February 16th, 1911.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JANUARY, 1911.

The January returns of electrical business show some shrinkage as compared with those recorded during the last half-year. The exports reached a total of £341,839 all told, and minus the telegraphic section, which reached only moderate dimensions during the month, the total of general business amounted to £305,953, a figure rather above the average obtaining during 1910, and comparing with £316,000 in December last, when there was in addition a huge telegraphic export.

The imports amounted to £207,430 in value, as compared with £260,285 in December, and were considerably above the monthly average of 1910. The re-exports remained fairly steady in value as compared with preceding months; the total was £22,759. As regards the exports, apart from telegraphic business, some falling off is noticeable in the machinery and cable sections, but in other directions, such as telephonic material, &c., an improvement occurred. The importation of lamps shows a decrease of nearly £35,000 in value, compared with the December returns, while cable and telegraphic imports also registered considerable decreases as compared with the previous return.

Japan was our best customer during the month, while India, Argentina and our South African and Australian Colonies were also prominent buyers.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric lamps and parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	379	196	32	43	77	2,407	360	92	59	309	1,057	5,011
Germany and German West Africa	128	334	121	228	724	1,115	125	18	...	45	2,053	4,891
Netherlands and Java	287	1,169	99	91	2	692	...	9	...	37	668	3,054
Belgium	639	416	19	171	39	3,032	488	2	...	2,383	16	7,205
France and French Indo-China	1,996	91	579	513	...	7,578	400	...	24	228	20	11,429
Portugal	73	60	226	...	...	34	300	26	...	228	94	1,041
Spain and Canary Isles...	293	...	16	126	286	1,369	24	30	...	...	4,118	6,262
Switzerland, Italy and Austria-Hungary ...	309	44	137	16	112	2,276	2	...	...	614	...	3,510
Greece, Roumania, Bulgaria and Turkey ...	69	...	23	94	3	456	...	...	...	235	103	983
Channel Isles, Gibraltar and Malta	66	144	46	600	4	333	30	2	...	...	87	1,312
U.S.A., Philippines and Cuba	209	...	19	141	173	514	5	1	732	...	340	2,134
Canada and Newfoundland	741	380	40	3,185	1,141	3,408	40	115	...	50	112	9,212
Bermudas, British West Indies and British Guiana	729	200	232	74	26	76	51	18	...	83	77	1,566
Mexico and Central America	27	531	...	131	...	89	...	8	...	114	...	900
Colombia, Venezuela and Ecuador	...	...	19	15	...	322	...	3	...	...	18	377
Peru and Uruguay	77	285	...	92	...	1,085	5	17	...	636	74	2,271
Chile	288	156	16	40	...	1,498	...	51	...	63	...	2,112
Brazil	454	2,279	143	440	472	5,183	5,878	206	43	358	1,542	16,998
Argentina	2,182	2,661	519	1,339	851	11,924	343	916	26	2,026	2,495	25,282
Egypt and Morocco	280	910	342	299	6	927	1,288	127	...	236	271	4,686
British West Africa and St. Helena	72	576	50	37	598	1,553	...	...	...	183	2,225	5,294
Cape of Good Hope	1,026	1,696	128	652	27	869	...	34	71	455	2,485	7,443
Natal	2,102	11,084	558	854	201	9,031	...	38	97	1,542	...	25,507
Rhodesia, O.R.C. and Transvaal	1,029	1,310	232	469	28	12,162	...	518	89	154	...	15,991
Zanzibar, Mauritius and Aden...	15	67	29	32	6	...	...	2	...	...	68	219
Madeira and Portuguese Africa	176	998	2	127	...	4,867	...	73	...	11	851	7,105
China and Siam	1,349	4,420	606	603	30	7,364	24	117	57	15	...	14,585
Japan and Korea	2,038	12,590	145	163	968	10,636	1,743	...	...	7,553	14,090	49,926
India	3,673	11,662	2,475	2,015	1,004	8,514	2,199	1,653	198	467	1,029	34,889
Ceylon	243	320	24	230	37	957	1,977	45	88	...	...	3,921
Straits Settlements and Fed. Malay States ...	589	2,084	238	512	308	1,379	767	87	86	194	36	6,280
Hong Kong	161	186	35	218	...	594	...	...	59	251	...	1,504
West Australia	352	293	52	824	75	2,738	...	79	...	1,531	...	5,944
South Australia	274	378	66	219	599	1,023	...	47	...	264	525	3,395
Victoria	708	9,445	79	1,076	268	4,503	...	355	...	2,939	455	19,828
New South Wales	2,136	4,223	247	1,003	574	7,538	580	470	17	1,192	304	18,284
Queensland	323	391	67	161	...	629	...	256	...	2,786	299	4,912
Tasmania...	176	148	...	...	...	53	...	...	...	...	...	377
New Zealand	770	2,106	233	437	7	1,936	12	83	...	241	374	6,199
Total, £	26,438	73,833	7,894	17,270	8,646	120,664	16,641	5,498	1,646	27,423	35,886	341,839

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Norway, Sweden and Denmark	...	...	5	110	...	2,222	70	549	...	4,360	7,316
Germany	257	8,546	1,903	34,743	2,593	49,438	2,212	1,589	7,708	26,214	135,203
Holland	15	...	...	2,878	...	72	...	...	65	60	3,090
Belgium	177	1,168	64	75	72	1,544	...	237	706	5,853	9,896
France	251	62	397	3,077	168	538	78	1,030	3,084	718	9,403
Switzerland	84	591	34	28	42	902	...	...	31	36	1,748
Italy	...	325	...	...	...	3	...	40	...	4,927	5,295
Austria-Hungary	...	536	10	1,967	...	103	...	14	3,525	88	6,243
Spain	...	...	...	24	...	...	...	...	480	...	504
United States	3,193	4	566	1,776	60	9,100	12,603	31	566	696	28,595
Total, £	3,977	11,232	2,979	44,678	2,935	63,922	14,963	3,490	16,165	42,952	207,293

Additional imports: Canada, goods, £137.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above	1,947	3,444	...	2,343	...	4,775	...	417	960	8,873	...

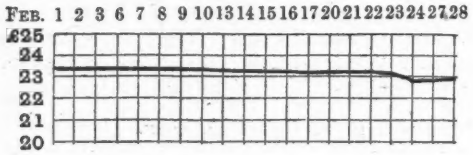
TOTAL EXPORTS: £341,839. TOTAL RE-EXPORTS: £22,759. TOTAL IMPORTS: £207,430.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

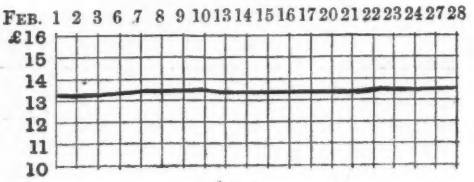
METAL MARKET.

Fluctuations in February.

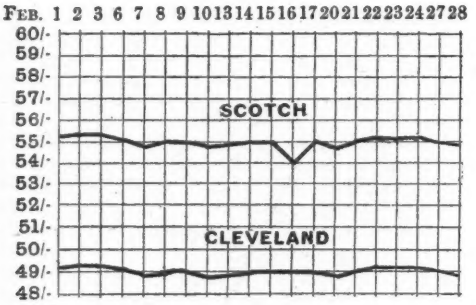
SPELTER (G.O.B's.).



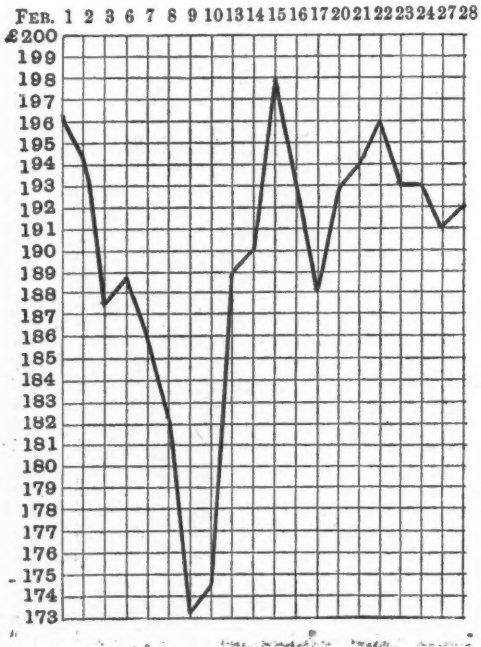
LEAD (ENGLISH).



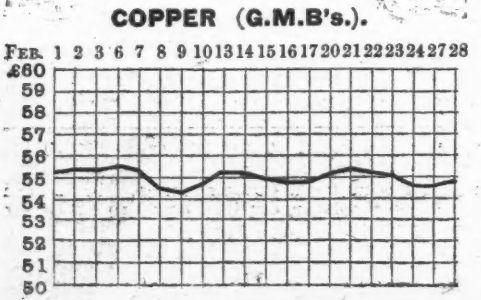
IRON.



TIN.



COPPER (G.M.B's.).



PROCEEDINGS OF INSTITUTIONS.

Breaking High and Low Potential Circuits.

By Alfred G. Collis, A.M.I.E.E.

(*Abstract of paper read before the* South Wales Institute of Engineers, *at Cardiff, on February 23rd.*)

In this paper are embodied the results of an investigation, under working conditions, of the behaviour of different types of apparatus, the function of which is the opening of electrical circuits.

In 1903 Prof. Bertram Hopkinson published the results of some experiments he made upon the effects of opening circuit-breakers on load, using a specially devised pendulum apparatus for obtaining his time measurements. The author has used an oscillograph for the same purpose, and it is interesting to note that there is an approximate agreement between the results as obtained by the two methods.

Mr. Miles Walker has shown that on a short-circuit the current increment may be at the rate of 800,000 amperes per second. Clearly the rapidity with which an electrical circuit is opened is a point of

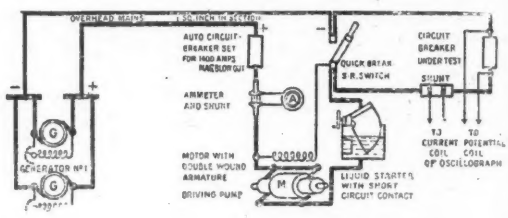
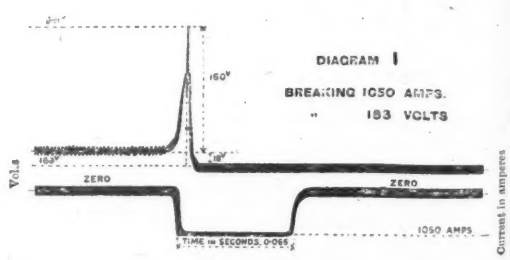

OVERHEAD MAINS
AUTO CIRCUIT-BREAKER SET FOR 1400 AMPS MAGBLOW OUT
AMMETER AND SHUNT
QUICK BRTAK S.R. SWITCH
CIRCUIT BREAKER UNDER TEST
SHUNT
TO CURRENT COIL OF OSCILLOGRAPH
TO POTENTIAL COIL OF OSCILLOGRAPH
GENERATOR No 1
MOTOR WITH DOUBLE WOUND ARMATURE
DRIVING PUMP
LIQUID STARTER WITH SHORT CIRCUIT CONTACT

Fig. 1.—Connections for D.C. Load Test.

great importance, because, apart from the fact that the rapid opening of a circuit having appreciable inductance may lead to excessive pressure rises, it must not be overlooked that if a short-circuit can be disconnected before the current can reach a dangerously large value, the rise of pressure may not be excessive, even with a very rapid break.

Particular interest attaches to the use of circuit-breakers with oil-immersed contacts for direct currents. Engineers are shy of using this compact and mechanical form of breaker for D.C. supply, for two reasons: (1) because the impression is widely prevalent that breaking direct current under oil must cause an abnormal rise of pressure owing to the assumed rapid disruption of the current, and (2) because of the carbonisation of the oil.

If it can be demonstrated that these difficulties do not in fact exist, the door will be opened to progress in the construction of switchgear for D.C. supply. It has been shown by Mr. W. Browning



Oscillogram 1.

that a contact immersed in oil has at least twice the conductance of a similar dry contact; and the contact is always in a condition of maximum efficiency.

From the point of view of the switchgear equipment of coal mines, experiments with oil-immersed contacts are of particular value. Probably an oil switch constructed to withstand a pressure of 200 lb. per sq. in. constitutes by far the safest method of opening circuits in mines where there is danger of explosion.

Undoubtedly more carbonisation of oil will take place with D.C. supply than with A.C., but careful tests that have been made show that the presence of free particles of carbon in the oil does not measurably affect its high insulating properties.

It is now generally understood that the construction of gastight cases is impracticable.

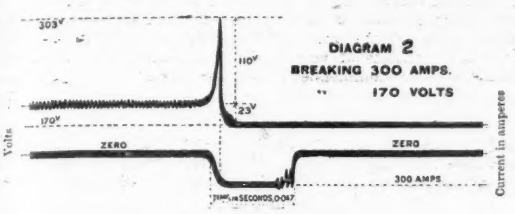
The terminal chamber of the oil switch may be fitted with gauze or "plate" protection, and it can then be made at a lower cost, because, as any pressure is at once relieved, the case can be made of ordinary strength. The gauze and plates must be correctly proportioned so that they provide sufficient cooling effect to extinguish the flames of the exploding gas, and they must be kept clean if they are to maintain their efficiency.

The following instruments were experimented upon:—

(A) Automatic circuit-breaker manufactured by the B.T.-H. Co., Ltd., with strong magnetic blow-out field continuously maintained. (Old type.)

(B) Automatic circuit-breaker manufactured by Cowans, Ltd., having a continuously maintained magnetic blow-out field produced by the same coil which operates the overload trip attachment to the switch.

(C) Oil-break switch manufactured by Cowans, Ltd., provided with brushes of the laminated type bearing on flat horizontal faces of the contacts under oil and moving in a vertical direction.



OSCILLOGRAM 2.

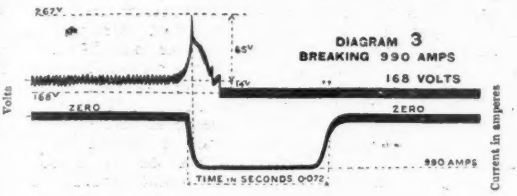
(D) Automatic circuit-breaker manufactured by the Switchgear Co., Ltd., with carbon break and no magnetic blow-out.

(E) Circuit-breaker manufactured by Cowans, Ltd., fitted with magnetic blow-out producing a field of medium strength, this field being produced by a separate winding, which does not carry current until the main brush ceases to make contact, and the whole of the current is passed through the auxiliary contacts. There were six turns of wire on the iron core of the magnetic blow-out attachment.

(F) Overload circuit-breaker exactly similar to E, but with only three turns on the core of the blow-out attachment.

(G) Circuit-breaker exactly similar to E, but with only one turn of wire on the core of the blow-out attachment.

(H) Porcelain handle fuse of the ordinary removable plug type, with fusible wire connected to castings cemented on each end of



OSCILLOGRAM 3.

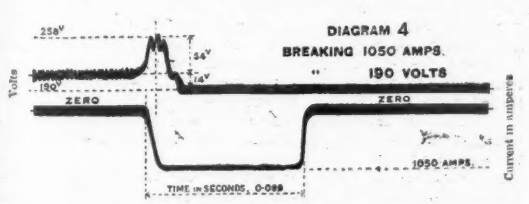
the porcelain tube, the fusible wire being threaded through the centre of the tube.

(I) Circuit-breaker exactly similar to C, except that water was substituted for oil and the circuit opened under water.

1. All the instruments were tested under the conditions shown on fig. 1, the two generators, which were run in parallel, supplying a current of about 920 amperes at 220 volts. The load consisted of an electrically-driven pump, which delivered against a pressure equivalent to a head of 120 ft. The quick-break switch marked S.B. was kept closed until the load was adjusted; when this switch was opened the load was thrown upon the circuit-breaker.

2. Instruments C, D and E were tested on a "dead" short-circuit, the capacity of the generator being 100 KW. at 230 volts, and the storage battery (110 cells) having a maximum rated discharge of 353 amperes.

Circuit-breaker A (strong magnetic blow-out).—Oscillogram 1 shows the current, pressure and time values during the interruption of a load of 1,050 amperes at 183 volts; the time occupied



OSCILLOGRAM 4.

was 0·066 second, of which 0·058 second was occupied in the operation of the mechanism of the breaker to the stage of commencing to open the circuit, and only 0·008 second in blowing out the arc. Prof. Hopkinson's results with a similar type of breaker were about 0·05 and 0·005 second respectively. Rise of pressure, 160 volts.

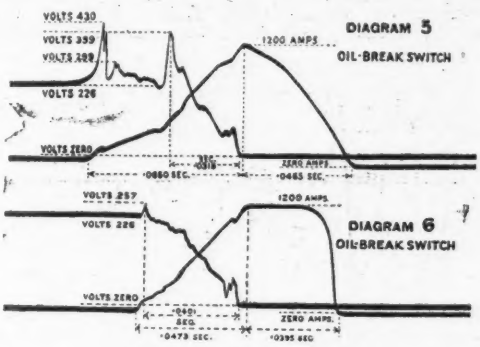
Circuit-breaker B (magnetic blow-out).—Oscillogram 2. The maximum current employed was less, but the pressure rise was greater in proportion.

Circuit-breaker C (oil-immersed contacts).—Oscillogram 3. The time occupied in operation was longer, owing to the heavier mechanism, but compared with breaker A the rise of pressure was much less, and the arc lasted longer under oil.

Circuit-breaker D (non-magnetic blow-out, carbon break).—Oscillogram 4. The results confirmed those of Prof. Hopkinson. The low pressure rise and the longer duration of the arc were noticeable. The rapid rise of pressure at the moment of disruption observed with A and C was absent in this case.

Circuit-breakers E and F (magnetic blow-out excited after main and intermediate brushes had left their contacts).—The blow-out coil being shunted by the arc across the intermediate contacts, a stronger field was obtained with the three-turn than with the six-turn winding, and the latter gave the smaller pressure rise. A wide break and a comparatively weak blow-out field are preferable to the short break and strong field formerly used, reducing the strain on insulation.

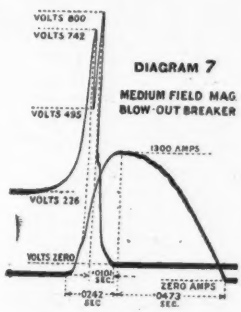
Porcelain fuse H.—One No. 16 S.W.G. copper wire, calculated to blow at 165 amperes. With 800 amperes at 180 volts the break



OSCILLOGRAMS 5 AND 6.

took place in 0·3492 second, with a pressure rise of 53 volts; E breaker took 0·0797 second, with a rise of 94 volts under the same conditions.

Circuit-breaker I (contacts immersed in water).—At 500 amperes, 180 volts, the rise of pressure was only 39 volts as compared with 66 in the case of oil. On dead short-circuit, oil-break circuit-breaker C gave oscillogram 5 with a D.C. generator and 6 with the



OSCILLOGRAM 7.

battery. The current reached 1,200 amperes, with a pressure rise of 200 volts at break in the former case; with the battery the absence of inductance was shown by the rapid rise to the limiting current of the battery and the small rise of pressure at final break. Circuit-breaker D (carbon break) gave a rise of 271 volts with the

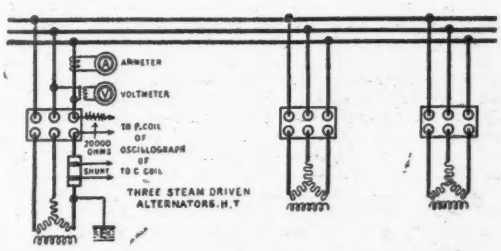


FIG. 2.

dynamo, and no rise above normal at all with the battery; the mechanism acted in the shortest time of all—0·0156 second to the commencement of the arc and 0·0396 to rupture it. Circuit-breaker E (magnetic blow-out) gave oscillogram 7, showing a rise of 574 volts.

The author concludes from these tests:—

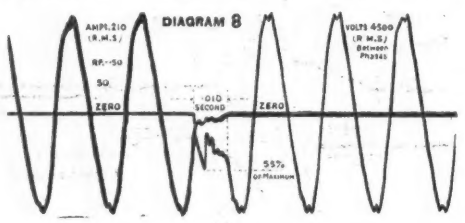
1. That within the limits of the conditions under which the tests were made the system of opening D.C. circuits by breaking contact under oil is safe and efficient.

2. That a breaker with a wide break and comparatively weak magnetic blow-out is a safer instrument to use on all circuits having an appreciable inductance than the type with short break accompanied by the necessarily strong blow-out magnetic field.

3. That a carbon break circuit-breaker tends to reduce the rise of pressure occurring at rupture of the current.

The alternating-current tests made were of two kinds: (1) high tension with inductive load; (2) low tension with non-inductive load.

The arrangement of the high-tension tests is shown on fig. 2. The plant consisted of three steam sets driving A.C. three-phase 6,500-volt generators of the rotating field type. The sets were first run up in parallel, after which the steam was cut off from two of them, the remaining set driving them as motors. The switch in circuit on the high-tension tests was of the electrical solenoid-operated type, having cone contacts with a break of 10 in. per pole per phase in a vertical plane. The power factor is stated on the

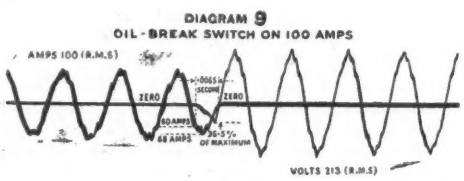


Oscillogram 8.

diagrams. In the A.C. diagrams the photographic film must be considered as moving from right to left; that is to say, the current curve which is indicated by the heavy line appears first, while the voltage shown by the thin line will make its appearance at the moment the current is interrupted.

Oscillogram No. 8 (210 amperes R.M.S.) shows that the current wave was interrupted as it was approaching zero value. There was an immediate inductive pressure rise, which appears to have been checked very suddenly, probably on account of the fact that the impressed voltage wave is endeavouring to establish itself in an exactly opposite direction to the direction of the induced volts. On the other hand, it would appear that it only required a period of time represented by one-half of the complete period, ·010 sec., for the voltage wave to establish itself in a normal manner, and it will be noted that the first complete half-wave of the voltage curve reached its normal maximum value.

In all cases the records show that the circuit may open at any point on the current curve; but after the current has died down to zero value, it never again rises on the other side of the zero line. It would appear, in fact, that in all cases the oil rushes in between the contacts, and prevents an arc being drawn out which otherwise might permit the current to rise again after it had passed through



Oscillogram 9.

zero value. It would appear that the final break invariably occurs at or near the point where the current curve would, in the ordinary course, have reached the zero line. In no case do the tests show any abnormal pressure rises; in fact, the inductive rise on opening the circuit in no case reached the normal maximum value of the impressed voltage—but these tests were made with comparatively small currents.

For the low-tension tests, an A.C. three-phase 40-KW. generator was driven by a 50-H.P. D.C. motor. The A.C. pressure was 230 volts. One of the phases was entirely disconnected, and the conditions were practically the same as if a single-phase generator had been used. A non-inductive load was obtained by the use of a water tank. Switch C was used having laminated brush contacts with auxiliary sparking pieces moving in a vertical plane with a 4-in. break per phase.

Oscillogram No. 9 (100 amps. 213 volts, oil-break switch) shows that the circuit opened at a point on the rising side of the current wave before the maximum value had been reached. The current tends to increase, even through the gap, but it does not reach the normal maximum value. The current then dies down to zero in the usual way. In this diagram, again, it is interesting to note the very sudden reversal of the E.M.F. wave just before the current reached zero value.

As in the case of the high-tension tests, there is a noticeable absence of pressure rise at break. So far as the tests were carried, they confirm the practice of the industry in the general use of oil switches for A.C. work. Water-break switches are seldom used now; but, apart from the inconvenience of the use of a conducting fluid which quickly evaporates, the water-break switch is an efficient instrument. The oil is, however, superior from every point of view as a medium for the immersion of the contacts, with the exception of its inflammability. A large volume of oil adds considerably to the factor of safety, and the oil should, of course, have a high flash-point.

In the table below particulars are given of the resistance between the carbon contacts of the breaker D, and also, for the sake of comparison, of the magnetic blow-out circuit-breaker E, including the resistance of the blow-out exciting coils. It will be seen that the carbon contact is relatively of very low conductance. With moderate currents this is not of serious consequence; but with heavy currents, such as are experienced in cases of short-circuits, some burning of the main brush is difficult to avoid. On that account the practice of using metallic contacts for the auxiliary breaks is to be recommended as a general rule.

	Carbon brush.			*Six turns magnetic blow-out.*		
Drop of volts ...	4·5	3·45	1·85	1·475	1·15	·74
Resistance in ohms	·0232	·0196	·0185	·00175	·00221	·00179
Current in amperes	204	176	100	840	680	415

Mr. E. B. Wedmore (British Thomson-Houston Co.) wished the experiments could have been carried out with larger powers. He did not see why the weak-field magnetic blow-out breaker was introduced, as its magnetic effect was only useful on heavy currents, and therefore for breaking smaller currents a large break had to be introduced. The existing carbon-break switches did the same thing, so that further complications were unnecessary. Breaking direct currents under oil produced excessive carbonisation of the oil, as was seen in some oil-immersed tramway controllers which had been tried. Owing to the small capacity of the generator the currents were not rapidly rising, as would occur on large power circuits when the break took place, and therefore no means of seeing whether comparatively slow breaks overheated the contacts was afforded. For enclosed switches the magnetic blow-out was useful as it prevented by its quick break the dissipation of the circuit energy in heat inside the box, and therefore they were useful, for example, in moderate powers on shipboard to Admiralty requirements. Oil immersion of contacts concentrated the arc on its point of starting, leading to rapid wear of the contacts, and there was a chance of setting fire to the oil with direct currents. The free-handle type of breaker gave a quicker break than the fixed handle, as the trip disconnected the handle at the beginning of the movement and allowed the brushes to get under way sooner. The switch used in the A.C. tests was out of proportion to the powers handled. He did not think that on heavy alternating currents the current was checked at zero, never rising again on the other side of zero line, as he thought the interruption was due to oil-cooling, and until this had been effected, the current would continue. Mr. Collis had referred to the reduction of contact resistance in oil; treatment of contact faces of breakers with machine oil or vaseline improved their contact resistance.

Mr. J. E. Teasdel referred to some comparative experiments he had made on a 2,000-ampere circuit-breaker and a 25-ampere fuse, short-circuiting them in series across a battery. The breaker had opened first nine times out of 10, and he adopted fuses to save the trouble of resetting circuit-breakers after a momentary lighting short. For power, every motor above 5 H.P. should have a circuit-breaker. He asked whether zinc tips had ever been tried.

Mr. W. A. Chamen (South Wales Power Co.) said the maximum direct short-circuit current in the paper was 1,200 amperes. On a large system they had, unfortunately, to deal with much more than that, and the paper might possibly be misleading on larger powers than those tested. He referred to the question of the influence of transformer iron on the E.M.F. wave, asking whether switching in on a certain portion of the wave might produce heavy current surges and damage which would manifest itself when the circuit was broken.

Mr. A. M. Taylor (Birmingham) contributed written particulars and diagrams concerning his new switch, the principal diagram being that exhibited at the Birmingham discussion on Merz-Price gear (Electrical Review, February 24th, page 322). The speed of working was important in reference to limitation of current on short-circuit. In his switch the voltage kick due to rate of change of current was reduced by resistance insertion to a reasonable figure. Even if the whole energy of the circuit was taken by the arc, it was estimated that 17,000 KW. could be interrupted with a cubic foot of air. In large American power systems the switching difficulty was so great that, at Chicago, for instance, they had to cut the switchboard up into groups.

Mr. W. B. Woodhouse (Yorks. Power Co.) had tried oil switches on direct currents, but carbonisation was so heavy that they were discontinued. They were used on coal-cutters, changing the oil every month, and answered satisfactorily with such precautions.

Mr. J. G. Statter drew attention to the oscillogram showing the persistence of fuses on overloads, and recommended time lags of the sucker type for switchboard breakers to stand up against slight overloads and break on dangerous ones. The dash pot was not always applicable, as it had a geometrical-progression curve.

Mr. E. W. Cowan, in his experience with direct-current oil-break switches, had found them work well in spite of oil carbonisation, so long as the carbon particles did not settle on the immersed insulators. The presence of carbon particles in oil did not seem to diminish its insulating property.

Mr. J. S. Peck (British Westinghouse Co.) thought the results obtained from small machines under special conditions could not be generally applied without danger. The carbonisation of oil in the direct-current switch was detrimental. There were already on the market other types of D.C. breakers operating quite satisfactorily. The figures given by Mr. Collis for voltage rises puzzled him, as the oscillograph pressure coil was across the breaker and measured the sum of the generator rise and motor drop due to the inductive kick, and hence the true rise was half, or even less, than

that given, as probably the motor had more impedance than the generator. He would like to know the effect of increasing the speed of the circuit-breaker, and of more circuit-induction. Mr. Collis had found an extinction of current on crossing the zero line in the A.C. tests, but other experiments showed that this depended on the quenching action of the oil. In a recent paper before the American Institution an oscillogram was given distinctly showing the rupture of current and then a rise on the other side of zero, this being commented on in the paper as persisting till the contacts were far enough apart to prevent further sparking across. What did the voltages in fig. 2 represent? He did not see, from the diagram of connections, how they could have been obtained. Possibly a permanent connection had been accidentally left across the other jaws of the breaker.

MR. COLLIS, in reply, said that, although there was more carbonisation with D.C. than A.C. in oil-immersed breakers, he knew of a 400-volt 800-ampere capacity breaker, operated several times per minute, giving no trouble with contacts or brush, and little with the oil. In mining work, there was the alternative between so-called gas-tight switch boxes and boxes filled with fluid. The latter were better, as the gas could not get in. Mr. Taylor's switch seemed good in principle, but constructional details in it were controversial. With regard to quick switching to limit short-circuit current rise, this depended on the capacity and inductance of the circuit. Generators to-day were being built with large impedances to limit momentary current surges. Mr. Peck's criticism of the voltage rises were, he thought, based on a misconception of what had been done. The current voltage, the inductive rise, and the difference between generator and motor-volts had beem summed to get the total. The only difference in the blow-out tests questioned, was the substitution of three for six turns on the blow-out coil of the same breaker. The oscillogram mentioned by Mr. Peck, if it was the same one he (Mr. Collis) had seen, was not accompanied by any circuit diagram or data of any sort, and was therefore hardly reliable evidence. The curves puzzling Mr. Peck showed voltages between phases when the breaker was open. Other results not given in the paper had been obtained in sequence with those exhibited, so that the tests were, he thought, representative of English practice.

Extra-High-Pressure Transmission Lines.

(*Discussion on papers by* MR. W. T. TAYLOR *and* MESSRS. MATTHEWS AND WILKINSON, *at the* INSTITUTION OF ELECTRICAL ENGINEERS, *London, January 26th, February 9th and 23rd.*)

PRIOR to the opening of the discussion, DR. JACKSON, President of the American Institute of Electrical Engineers, in the course of some remarks, said that in America the distance over which coal had to be carried to the market, and its high cost, turned the balance in favour of water-power with high-pressure transmission. One reason for the three-phase H.T. transmission was the ease of obtaining the necessary plant. Direct current was used for distribution; high-voltage generators up to 20,000 volts in pressure in large units were used in one instance. Pressures of from 35,000 to 60,000 volts were used to transmit energy to interurban railway routes, and the lines were in charge of railway employés, and gave no trouble in working. A great deal of work was necessary before higher pressure transmissions—up to 400,000 or 500,000 volts—would become practicable, but he thought the corona and convection current troubles would be overcome.

MR. B. WELBOURN thought the papers rather left cable transmission out of the question; makers were prepared to supply 30,000-volt A.C. and 100,000-volt D.C. cables if required. The authors had somewhat neglected M. Thury's work on his 58,000-volt D.C. transmission. In this country a good many pole lines were in use, but with the treated poles used, the pole life would be nearer 25 years than 12; the usual spans were 80 yards, but there was one of 368 ft. in use for a special purpose. He had found a great diversity of opinion as to the necessity for continuous earth wires; one Canadian engineer had given it as his experience that both earthed and unearthed lines were struck indiscriminately. An earth wire formed a good bond for the poles, but if it corroded away, it would be difficult to renew it unless the line were made dead. Aluminium wire had come into use, in sizes between No. 12 gauge and 1·48 sq. in. section; from his observation it was reliable under weather and other conditions, and he had been told that it did not collect so much sleet as copper wire.

MR. S. G. REDMAN said he endorsed Mr. Taylor's remarks on lightning arresters, of which several patterns were employed on the North-East Coast. He had found wires did not always swing synchronously, and in a gale he had known them touch. The arrangement of railway crossing shown would not be admitted in this country. While showing some interesting slides of transmission work carried out on the North-East Coast, he remarked that there would be about 130 miles of 20,000-volt line, mostly overhead, by the end of this year. The A-pole arrangement had been adhered to, but the spans had increased from 40 to 80 yards. The earth wire was frequently carried below the transmissions, and formed the supporting wire for the lead-covered pilot wires used in connection with protective system employed in those lines. The pilot cable was treated much as a trolley wire, carried level with easy bends at corners. At railway and road crossings, the transmission was carried through a series of square frames, strung about 20 ft. apart by their corners; the bottom member of the frame was of wood, and an earth wire was provided half-way between the frames, and it would be difficult for a wire to touch the ground. In conclusion, he showed an interesting outdoor sub-station carried on transmission poles, which is in use for supplying Ponteland, near Newcastle.

MR. A. P. TROTTER (Board of Trade) said our short-distance transmissions did not call for very high pressures, which would involve unwarranted terminal expenses. He thought everything would be more expensive but the line, and that 20,000 volts or so was a practical limit here. One could hardly go so far as to regard wooden poles as things of the past in this country, especially for pressures of 20,000 volts; in the discussion on Wade's paper, some time back, it was suggested that the creosoted pole might reach a life of 50 years, and Major O'Meara had suggested an average of 30 or 40 years, at a time when impregnation processes were not so perfect as now. Over here it would hardly pay to use the steel pole. The question of slinging cables ¾ mile across the Tyne had been discussed, but the towers were too costly; but Messrs. Edmundson were putting up a 600-ft. span on 140-ft. towers at Hayle Harbour, so that we were not quite out of date. As regarded flexible poles, it was not so much a question of deflection as of the stress when the line was wrecked. He asked whether wayleaves were granted in the States by the local authorities and railways for transmissions along their routes.

MR. J. S. PECK said it did not pay to transmit over distances beyond which one could pick up a paying load. The probable paying limit of pressure was under 200,000 volts. He could not agree with all Mr. Taylor's conclusions. It was scarcely probable that anyone would run a 6,000-H.P. motor direct from the line, and he did not think lightning arresters were required on the L.T. side of the transformers, as the L.T. windings could be well insulated. He illustrated a lightning arrester consisting of alternate concrete blocks and metal sheets, with horn spark gaps in series, which was now being adopted for 100,000-volt circuits.

MR. W. H. CLOTHIER said he noticed that five or six different systems of protection were shown diagrammatically in Mr. Taylor's paper, and the principal consideration appeared to be to provide for the safety of the controlling apparatus. They appeared to accept breakdown as inevitable, and nothing was shown which was comparable to the balanced system of protection adopted on the North-East Coast systems.

MR. W. B. ESSON said the first Italian poles were rigid in all directions and very expensive, but the original Semenza design—which represented the first so-called flexible pole—provided strength only in the direction where it was wanted; elasticity was an incidental and the cost was much less. American practice seemed very loose as regarded foundations, judging by the papers. He thought the rule for spacing of conductors was first given by himself in an article in the ELECTRICAL REVIEW during 1905. From Mr. Matthews's paper, it seemed that star and delta connections were about equally used up to 60,000 or 70,000 volts; at 100,000 volts delta seemed to be the choice. One would have thought that star connection would be more general on account of its limiting the pressure to earth. An American engineer has given it as his opinion that it was easier to operate at 60,000 volts than at half that pressure. With smaller current at higher voltage there was less surge pressure.

MR. A. A. CAMPBELL SWINTON said the real limiting factor of pressure on overhead lines was the corona or brush discharge, and there might be some scope for larger diameter wires, such as aluminium wires, for this reason. In view of the lengthy spans which could be used, steel wire might be considered. A polished surface was against brush discharge, so it was probable that it would increase in magnitude as time passed and the wires corroded. He thought that a thin film of air was better than any solid insulator, and it was therefore doubtful whether brush discharge could be prevented by insulating the wire, and so the only way was to increase the diameter of the wire.

DR. M. KLOSS gave same details of transmission work carried out by the Siemens-Schuckert Co. on the Continent, including the 110,000-volt transmission scheme, to which reference has been made in our Continental notes. He thought from the curve shown in Messrs. Matthews and Wilkinson's paper, that the lines should be worked just below the critical point in pressure, where the brush discharge appeared to take place.

MR. C. P. SPARKS, commenting on the absence of large transmissions here, said our maximum would be 4 or 5,000 KW. per feeder, as against 20 or 25,000 KW. mentioned in the paper. He considered that we should be forced to use higher pressures than 20,000 volts eventually, possibly 40,000 volts, otherwise it would not be possible to transmit the power which might be required. There were no great additional difficulties in using higher pressures. The first essential here was continuity of service, and this did not appear to have been touched on by the authors; the methods of protection shown were crude and would lead to consumers being isolated. In view of the rapid increase of corona and insulator loss as the higher pressures were reached, he considered that 200,000 volts must be an outside limit. As regarded direct-current transmission, the difficulties in sub-station and generating apparatus more than made up for any advantages it might have in the line itself. Better earthing appeared necessary, than would be obtained by letting the feet of the towers project through the concrete. Concluding, he pointed out that water-power development did not mean cheaper power than could be obtained in this country.

MR. W. B. WOODHOUSE said he had several hundred miles of H.T. overhead wires in use, and emphasised the difficulty experienced in obtaining wayleaves. This was a matter which the Institution might take up, with a view to securing an amendment of the law, somewhat on the lines of Continental legislation. Any local authority here could, without reason, refuse to allow a line, even if it ran on private property.

MR. E. J. FOX said that in many quarters wooden poles were considered to have a life of 20 or 30 years or equal to that of steel poles. But the cost of wood was increasing and steel was becoming cheaper. The tubular pole was much used on the Continent, and as regards both price and weight, it had an advantage over the built-up pole

of angle-steel. For transportation and erection the lighter sections were obviously advantageous.

Mr. A. Jacob said that between 200 and 300 miles of aluminium wire had been used on the Canadian Hydro-electric Commission's lines. The factors of safety in England were at least twice those to which the above lines were designed, notwithstanding the worse weather conditions prevailing in Canada, and this, in turn, increased the comparative cost of such lines in this country. The formula used here took no account of elasticity. The jointing of aluminium wires was now satisfactory; in the earlier lines, clamps and binders of copper were used, and electrolytic action resulted. The tensile strength of such wire could be increased by using a copper alloy, but this would decrease the life and increase the resistance. Aluminium was considerably cheaper than copper—in one case cited by Mr. Taylor, there would have been a saving of £18,000 by using it. In one case, in South Wales, single aluminium wires had been used with success.

Mr. C. J. Greene pointed out that calculations in which the amount of sag was indirectly a factor, were liable to vary considerably, owing to the variation of the wind from day to day. If the tension in the wire was obtained from this, the factor of safety would be doubtful. As regarded the clamp joint mentioned by the previous speaker, it had only 60 per cent. of the strength of the line when tested in a machine. It seemed probable that the light aluminium wires would swing out of phase in a wind, especially if they were not equally taut. He had built up wooden tripod poles 100 ft. high, carrying six conductors, for use in the country.

Mr. E. H. Rayner commented on the large amount of power required to supply line current only; 20,000 volts seemed a low pressure to use in view of the small extra cost involved by high pressures. He had recently tested some H.T. insulators which had given trouble on an Indian transmission line, and his conclusion was that under heavy rain these insulators would become waterlogged, due to their not being glazed on the bottom edges of the petticoats. He showed a series of excellent lantern slides illustrating the flashing over of insulators under test, the discharge of horn arresters, &c., and remarked that people scarcely realised that all wet insulator surfaces were practically the same as if metal covered, giving a comparatively short path for a flash-over from line to support.

Mr. H. Brazil, commenting on the use of lightning arresters, said they should not cause any disturbance in the system, as suggested in the papers. The electrolytic arrester required discharging daily to keep it in order, and the electrolyte was not reliable. Mr. Peck's views showed nothing more than horn gaps with a resistance in series, and he thought a small resistance in series was advantageous as preventing the earthing of the whole system.

Mr. B. M. Jenkin said we had no long distances over which to transmit energy, requiring high pressures, but the trouble which was experienced in obtaining wayleaves made it desirable to use single-pole lines, and a high pressure would be necessary in that case in order to transmit sufficient power at reasonable cost. Comparatively little extra cost was entailed by the additional insulation for the higher pressures.

Mr. A. J. Stubbs, referring to the experience of the Postal Telegraph Department, said that tests of loading for short and long periods, with aluminium and copper wire, showed that the latter reached a limit in elongation, much quicker than the former. In considering the elastic limit—the point beyond which permanent elongation took place—tests showed this point to be reached by aluminium at 2,900 lb., by aluminium-bronze at 3,200 lb., and by copper at 8,000 lb. per sq. in. The trouble with aluminium was the difficulty in soldering it; mechanical joints were not satisfactory for telegraphic and telephonic purposes. The Britannic joint was perfectly satisfactory, both mechanically and electrically. He pointed out that P.O. insulators did not depend for their insulation on the glaze, which could be removed without detriment.

Mr. F. V. T. Lee, referring to experience on Pacific transmission systems in the States, drew attention to the importance of using synchronous motors on the line, and said motor-generators were preferable to converters. The system he referred to had 11 power houses, with 67,000-kw. of plant installed, and in such a case it was impossible to regulate voltage from the power houses. The difficulties of wayleaves and pressure limits were coming to the front in California; in some cases it had been found better to go round towns with transmissions, rather than face local restrictions, but in future these matters would be settled by a public service commission. Great trouble had been experienced with lightning arresters, and they had finally come to use the horn gap type; this type was used on all the lines of the Pacific Electric Co., with practically no resistance in series. The difficulty of repairing with a single pole line carrying two circuits, left it not much better than a single-circuit line; the best practice was to have two lines following different routes. Single-phase transformers were better than three-phase transformers in large sizes—say, above 1,000 kw.; the effect of a short circuit in a three-phase transformer was more serious. They favoured a horizontal oil-break switch at 60,000 volts, which had been designed by the staff, but it might not be satisfactory at 100,000 volts. The use of telephone wires on the main pole lines had been abandoned for operating purposes, owing to the trouble when a breakdown occurred; the local telephone company's lines were now used for operating, and the original wires for repair work. A fair average life for wood poles in California, which were untreated, was 10 years, but concrete poles were used, as both wood and steel were more costly. The original transmission lines were built with windmill towers. Owing to the trouble with insulators, it had been found cheaper to reduce the number of towers down to, say, 10 to the mile, as against 40 used formerly. American insulators did not usually depend on glaze for insulation; he thought the interlocked suspension insulator was better than the other types. It was not possible to duplicate lines for less than the cost of providing a stand-by plant, and this stand-by was absolutely necessary in busy cities and towns. The question of reserve plant was not so urgent for the street railways and small towns, but it must be provided for a big town.

Mr. R. Borlase Matthews, owing to the late hour, agreed to communicate his reply, but pointed out that one of the lines mentioned in his paper had already been run at 300,000 volts, and that there were two projects in view, in which 165,000-volt lines were being considered. The majority of the line troubles, he thought, occurred between 30,000 and 80,000 volts.

LEGAL.

Marconi and Others v. British Radio-Telegraph and Telephone Co., Ltd.—Judgment.

By this action the plaintiffs, Mr. Marconi and his company, sought an injunction and other relief in respect of an alleged infringement of patents 7,777 of 1900, and two other patents dated respectively 1902 and 1907. The defendants denied infringement and disputed the validity of the patents. By arrangement, only the 1900 patent was dealt with, the case with regard to the other two being postponed until the first was decided. The proceedings have already been reported in our columns.

In delivering his reserved judgment, Mr. Justice Parker said that it would be convenient first to say a few words on the subject of wireless telegraphy generally, as only in that way could a proper conclusion be reached as to the nature of the invention and the problems which its practical application had involved. Wireless telegraphy, in the sense that he was using the expression, operated by means of disturbances in the ether produced by the discharge of a Leyden jar or other condenser, and in that respect must be distinguished from inductive telegraphy which, though it also operated without the aid of wire conductors, depended for its effect on the current which was induced in a circuit, when it was cut by the magnetic field created by an electric current in another circuit. His Lordship proceeded to trace the successive stages in the history of the subject up to the work of Hertz. In 1892 the results of Hertz's experiments were becoming generally known, and Crookes, for the first time, suggested that it might lead to a system of wireless telegraphy based on the creation and detection of ether waves. In 1893 Hertz died, and in the following year Lodge lectured at the Royal Institution on Hertz's work in connection with ether waves, which lecture was afterwards repeated at Oxford. That was an event of great importance, for not only did it bring the subject prominently before the scientific world, but it explained with great exactness the various difficulties attending the full utilisation of the principle of sympathetic resonance for the purpose of detecting ether waves. It was these difficulties that Marconi claimed to have overcome by the invention which was the subject of the patent in question. To start a clock by gently tapping its pendulum, not only must the taps be rightly timed with reference to the time period of the pendulum, but there must be a long series of taps of approximately equal strength. In like manner, if the principle of sympathetic resonance was to be utilised to its full extent in the detection of ether waves, there must be a long series of waves of equal, or approximately equal, amplitude. Such a series of waves could only result where the oscillations from which they proceeded occurred in a circuit which lost its energy very slowly, for as the energy in the circuit decreased, so did the amplitude of the ether waves which it created. It must not, therefore, waste its energy, either by internal resistance or by giving it out too rapidly to the surrounding ether. On the other hand, if ether waves were to be detected at any great distance, they must be waves of substantial amplitude, for their effect diminished as the square of the distance, and to create waves of any substantial amplitude, the oscillating circuit must give up its energy readily to the surrounding ether. It followed, therefore, that a circuit that was a good conserver of energy, and one that was capable of creating a series of waves of approximately equal amplitude, was a bad radiator. On the other hand, a good radiator which would, perhaps, surrender 75 to 80 per cent. of its energy to the ether during each oscillation was necessarily a bad conserver of energy and would not create a long series of waves of approximately equal amplitude, but would give one big wave, followed by a short train of waves of rapidly diminishing amplitude. Looking at the problem from the detector point of view, there was a similar difficulty. A good radiating circuit might be a good absorbing circuit, but it would not be a good conserving circuit. In other words, the more susceptible it was to the ether waves, the less it was fitted to accumulate and store up the effect of a train of waves, because of its tendency to part forthwith with any energy it received. In one of his experiments, Lodge showed that he used an approximately closed circuit with a radiator and detector. He pointed out that a closed circuit was available. In June of 1896, Marconi applied for his patent, No. 12,039, in connection with wireless telegraphy. That was the first patent ever granted for a system of wireless telegraphy based on the creation and detection of ether waves. In this he used an open circuit and tuned the two circuits together as Hertz had done, but replaced the horizontal Hertz radiator by a vertical wire of considerable height connected through

a spark-gap to the earth. With the apparatus described in his first patent, Marconi, in 1897, without the aid of any subsequent improvement, succeeded in sending messages over a distance of many miles, and thus fully demonstrated the possibility and utility of a system of wireless telegraphy based on the creation and detection of ether waves. Marconi's 1896 patent had, however, considerable drawbacks. Not only could it not send out such a long train of waves, but the electrical energy that could be got into the transmitter was somewhat limited. It was necessary to bear that drawback in mind in considering the next patents. Lodge, in 1897, took out a patent for scintillating telegraphy, in which he returned to the problem of using resonance, but for practical purposes it was of no great moment. Later in the same year Lodge applied for another patent, but he (the learned Judge) did not think that that patent threw any light on the use of resonance for a system of telegraphy based on the ether wave. Following that was Prof. Silvanus Thompson's patent of 1898 and Marconi's patent of the same year, which disclosed, amongst other things, an improved receiver in which the aerial was connected to earth through the primary of a transformer, the secondary circuit of which contained the coherer. Marconi's object was to step up the voltage so as to ensure that the coherer would be more readily affected. Marconi subsequently obtained two further patents, and that was all that need be mentioned for the interpretation of the patent of 1900. It had been preceded by Braun's patent, which had been relied upon as an anticipation, but there was no evidence that Braun's patent had become generally known at the date of Marconi's 1900 patent. He would proceed, therefore, to consider Marconi's 1900 patent. The inventor commenced his specification with the statement that the object of the invention was not only to increase the efficiency, but to secure selectivity. To any electrical engineer that statement would at once suggest Lodge's patent of 1897, and the difficulty it was intended to meet—namely, that of increasing the available store of energy in the transmitter. But it was necessary to secure such a series of waves as would ensure selectivity. The claims of the patentee were reasonably clear. The first was for a transmitter for electric wave telegraphy consisting of a spark producer having its terminals connected through a condenser with one circuit of a transformer, the other circuit being connected to a conductor and to earth, or a capacity, the time period of electrical oscillations in the two circuits being the same, or harmonics of each other. He thought the words "or capacity" were only introduced in case some one using the invention should say there was no infringement because there was no earth connection. He thought that was the true, and indeed the only possible interpretation, to put upon the patent. All the scientific witnesses agreed that the cumulative effect of the oscillations in one circuit upon another circuit tuned to it depended upon how the two circuits were coupled together. To get the full cumulative effect, the circuits must be what was called loosely coupled, for the effect of the tuned primary on the tuned secondary diminished as the coupling was tightened. There was no express direction in the specification as to whether the circuits were to be loosely or tightly coupled; but, again, all the scientific witnesses were at one in thinking that, to an electrical engineer, the direction in the 1900 specification to get a cumulative effect on one circuit by means of the oscillations in another tuned to it would in effect be a direction to couple the circuits loosely, though the defendants' witnesses doubted whether they would have read the specification as giving such an injunction to get a cumulative effect on both circuits. Though there was no specific reference to it in the specification, on his interpretation of it, he came to the conclusion that there was a direction to couple loosely, and he need not further pursue the matter. As he interpreted the patent, the essential features of the invention thereby disclosed were as follows:—In order to get over a well-known difficulty in applying the principle of resonance, as between transmitter and receiver in a system of wireless telegraphy, a difficulty involving the impossibility of a single circuit being at once a good radiator or absorber, and a persistent oscillator, the inventor proposed to substitute for a single circuit in both transmitter and receiver, a pair of circuits, one of which was so constructed as to radiate or absorb readily, and the other of which was so constructed as to oscillate persistently, and be a good conserver of energy. The two circuits of the transmitter were tuned together and linked by means of a transformer, in such a way that the electrical oscillation in the closed and persistently oscillating circuit built up, and inasmuch as the primary could act as a reservoir of energy for the secondary, maintained, similar oscillations in the open and readily vibrating secondary. Similarly the two circuits of the receiver tuned to the same time period as the circuits of the transmitter were linked through a transformer in such a way that electrical oscillations in the readily absorbing primary built up similar oscillations in a closed and conserving secondary until such oscillations had strength to break down the coherer. It was not disputed that if this was the invention, it did get over to a very great extent, if not entirely, the difficulty it was designed to meet. Further, if that was the invention, its utility was undoubted, for it at once doubled the distance to which effective messages could be sent by means of ether waves, and effectively secured selectivity in all cases in which the receiving stations were not so near as to be disturbed by single waves, or the first three or four waves of a series. Having ascertained the essential features of Marconi's invention, he would proceed to ascertain whether it had been anticipated by Braun's patent. Braun's invention had many difficulties. It was reasonably clear that Braun was imperfectly acquainted with what was being done by Marconi. By reason of the lower vibration his length of operation was limited, otherwise the vibrations would be damped too much. That meant that the effective potential was limited. There was a great deal of controversy at the trial as to what Braun's figure really meant, and whether it was sense or nonsense, and he did not think any complete agreement was arrived at. It was by no means clear what Braun was referring to unless it was the Hertz wave, but he was satisfied that the letterpress of Braun's specification did not contain the remotest reference to the problem that Marconi's patent of 1900 was intended to solve. In his opinion, any competent engineer would have put Braun's specification entirely on one side as being founded on a mistake. He would have said that Marconi was already doing what Braun had not done. If he was right as regards that, that disposed of anticipation, and he would proceed to consider the objections based on want of subject matter. In considering the plea of want of subject matter, it was important to notice that in the receiver the mere introduction of two circuits instead of one was no novelty. A figure in Lodge's 1897 patent showed the open circuit to be the receiving aerial linked through a transformer with a closed circuit containing the coherer, his idea being, as he stated, to have his receiving aerial free to vibrate electrically without disturbance from attached wires. This secondary circuit as shown was not tuned to, nor could it be tuned to, the circuit of the aerial. This, in his (the judge's) opinion, was exceedingly strong evidence that Marconi's 1900 invention was not so obvious as to deprive it of subject matter. In the literature that had been quoted there was no trace of the idea underlying Mr. Marconi's invention, nor so far as he could see a single suggestion from which a competent engineer could arrive at the idea. He held, therefore, that the plea of want of subject matter entirely failed. The only other plea of invalidity was based on suggested prior grant contained in Braun's second patent of 1899, the complete specification of which was not accepted or published until after the date of Marconi's 1900 patent, and which therefore could not be relied upon as an anticipation. This plea of prior grant was not, he thought, really pressed, and he could not see how it could be said that this patent contained a grant of the invention described in Marconi's 1900 patent. Having come to the conclusion that Marconi's 1900 patent was a good and valid patent, he had to consider the question of infringement. The defendants proposed to make use of a system of wireless telegraphy called the Balsillie system, fully described in a pamphlet entitled "The Balsillie System of Radio-Telegraphy," which had been put in at the trial. It was admitted that they had offered for sale apparatus made substantially in accordance with this pamphlet, and had actually sold and installed such apparatus on board a ship called the *Nonsuch*. Further, it was reasonably clear on the evidence that the apparatus described in the pamphlet and actually installed on the *Nonsuch* had certain characteristics from which it would appear that the defendants' apparatus contained all the essential features of the invention patented by the Marconi 1900 patent. How then could it be said that there was no infringement? The defendants relied upon the distinction between transformers and auto-transformers. He was satisfied that if at the date of Marconi's 1900 patent a competent electrical engineer conversant with wireless telegraphy had had Marconi's invention explained to him and had been asked whether one could substitute for Marconi's two-coil transformer an auto-transformer, whether arranged one to one or otherwise, he would unhesitatingly have answered in the affirmative, and if that was so, the use of the air-core auto-transformer, even if arranged one to one in Marconi's system, could never have afforded subject matter for a new patent or have been called a new discovery. Under the circumstances to which he had referred it was not unnatural that the plaintiff should be able to quote numerous cases in which the word transformer had been used to include auto-transformers, or in which an auto-transformer had been called a transformer, and that, on the other hand, the defendants should be able to quote numerous instances in which an instrument was called an auto-transformer to distinguish it from the ordinary transformer with two coils. When the word transformer was used its meaning must depend largely on the context. The defendants' apparatus seemed to him to contain everything of real value in every single claiming clause, the only difference being that the necessary inductive linkage was supplied through the auto-transformer and not through the two-coil transformer, and this in no way affected the result. It was a well-known rule of patent law that no one who borrowed the substance of a patented invention could escape the consequences of infringement by making immaterial alterations. From that point of view the question was whether the infringing apparatus was substantially the same as the apparatus said to have been infringed. In the present case he could not doubt that a jury would say that the defendants' apparatus was substantially the same as that shown in Marconi's 1900 patent. Again, where the patent was for a combination of parts or a process, and the combination or process, besides being itself new, produced new and useful results, everyone who produced the same results by using the essential parts of the combination or process was an infringer, even though he had, in fact, altered the combination or process by omitting some unessential part or step and substituting another part or step which was in fact equivalent to the part or step he had omitted. The question here again was one of the essential features of the invention said to have been infringed. If that part of the combination or that step in the process for which an equivalent had been substituted, was the essential feature or one of the essential features, there was no room for this doctrine of equivalents, and to ascertain the essential feature of an invention, the specification must be read and interpreted by the light of what was generally known at the date of the patent. Being of the opinion that every claiming clause of Marconi's patent of 1900 was a claim for an entirely novel combination producing an entirely new and useful result, and that the use of a two-coil transformer was no essential part of his invention, he must hold that the defendants who, in his opinion, had taken all the essential parts of the invention, were infringers, notwithstanding that they had substi-

tuted an auto-transformer for a transformer in the combination claimed, and notwithstanding that the use of an auto-transformer with an air core for any such purpose as that for which Marconi has used the transformer, might have been new. The action, therefore, in his opinion, succeeded.

Mr. Hunter Gray, for the plaintiffs, asked, in addition to the injunction, for a certificate of validity and costs upon the higher scale.

Mr. Colefax, for the defendants, objected to costs being given on the higher scale.

After hearing authorities cited, his Lordship came to the conclusion that it was not a case where costs should be allowed on the higher scale, but he would certify for three counsel.

Mr. Hunter Gray asked for the costs of the action, except so far as they had been increased by the issues as to the patents of 1902 and 1907. Those two patents merely related to an improved spark-gap and a detector, and there was no need to go into them until this patent had been ultimately decided.

His Lordship said there would be a set off as to costs, and the rest of the action would stand over generally with liberty to apply.

Mr. Colefax asked that the operation of the injunction might be suspended if notice of appeal was given within 14 days. He understood that the defendants' apparatus had been fixed on ships, and there would be considerable difficulty in getting it off those ships.

Mr. Gray objected to the injunction being suspended generally, but said that the plaintiffs would be quite willing to meet the defendants in any case of exceptional difficulty. The injunction was a very important thing to the plaintiffs.

His Lordship said he thought the proper thing would be to give notice of appeal, and the operation of the injunction ought to be suspended pending the appeal. There would be judgment for the plaintiffs in respect of the first patent with costs, except so far as the costs had been increased by joining the other two patents; there would be an injunction, delivery up of the infringing articles, and an inquiry as to damages, the costs of such inquiry to be reserved.

Pilkington *v.* Edinburgh School Board.

In the Court of Session, before Lord Dewar, the record was closed and proof ordered in an action by Basil A. Pilkington, electrical engineer, Edinburgh, against Edinburgh School Board, for payment of £73 9s. 4d., the amount found to be due to the pursuer by an arbiter after a reference on questions between the parties in regard to work which the pursuer had done for defenders at Tower Bank School, Portobello. The defenders maintain that they are due the pursuer only £19 8s. 6d. They paid him for items in his account not in dispute £320 12s. 2d. To this they add £73 9s. 4d. allowed by the arbiter, a total of £394 8s. 6d. They have already paid the pursuer £375, leaving a balance of £19 8s. 6d., which they admit is due.

The Langdon-Davies Motor Co., Ltd.

In the Chancery Division, on Friday, February 24th, a motion was heard before Mr. Justice Swinfen Eady. Mr. H. E. Wright said it was a motion by a debenture-holder holding three £300 debentures, for the appointment of a receiver and manager. The company was formed in 1905 to carry on the business of manufacturing alternating-current motors according to certain patents. In the year of its incorporation it issued debentures to the amount of £5,000. All these were outstanding and they constituted a floating charge. The principal money became due if, among other things, the concern went into liquidation. The company had passed at an extraordinary meeting a resolution for voluntary winding-up, and in view of this counsel now asked for the appointment of a receiver and manager. The company had a considerable number of contracts for the supply of motors, &c.

His Lordship made the appointment, limiting the managership to three months.

Reorganisation and Control, &c., Co., *v.* The International Motor Traffic Syndicate, Ltd.

In the Chancery Division, before Mr. Justice Neville on Monday, February 27th, the plaintiffs in this action moved for leave to serve notice of motion upon the defendant syndicate that the plaintiffs should have leave to restore the action upon two points.

Mr. Jenkins, K.C., who made the application, said that it was made under somewhat peculiar circumstances. The action, he reminded his Lordship, was brought to have it declared that certain omnibuses, which were the property of the Electrobus Co., had been wrongfully assigned to a Brighton Omnibus Co., who were the second defendants, and should be delivered up to the plaintiffs. The claim against the Brighton Co. for delivery up was dismissed with costs, but against the International Motor Traffic Syndicate there was a claim for damages for wrongful sale. On that, an inquiry was directed as to the sale of certain omnibuses, and no order was made in respect of costs. Since the judgment, it had been discovered that 19 Tudor accumulator batteries, which were sold for £100 apiece, making £1,900, were the property of the Electrobus Co. It was admitted at the trial that these batteries were at the garage of the old company, the London Electrobus Co., Ltd., but it was stated that they were not the property of that company, but were the property of the Tudor Accumulator Co. It had since the trial been discovered that that was entirely false, and unless some explanation was forthcoming, the matter had a very serious aspect. Mr. Riding was called as a witness for the plaintiffs, and spoke of these batteries being hired to the Electrobus Co. by the Tudor Co., and after he had left the witness-box he told Dr. Lehwess, who was interested in the defendant syndicate, that he had made a mistake in respect of them, and Dr. Lehwess replied that it did not matter, as it would be put right afterwards. The matter was, however, not put right, with the result that the inquiry as to damages was confined to the electrobuses themselves, and did not include these batteries. It appeared from inquiries of the Tudor Co. that they supplied the batteries under an agreement of February 12th, 1908, under which the batteries were to become the property of the Electrobus Co. on the payment of the final instalment of the purchase-money, though they remained the property of the Tudor Co. until it was paid. All the instalments had been paid, and therefore the batteries had become the property of the Electrobus Co., and should be accounted for.

His Lordship asked whether that would not come out in the inquiry.

Mr. Jenkins said the inquiry did not include the separate parts, and he would further submit that the plaintiffs could now show a *primâ facie* case for an inquiry, and, therefore, the costs of the action so far as the International Co. was concerned should be reserved. He was not seeking to disturb the order so far as the Brighton Co. was concerned.

His Lordship gave leave to serve the International Co. with notice of motion for Monday next.

Marsh *v.* Cama Moolla & Co.

In the Lord Mayor's Court on Friday, before the Common Serjeant (Sir F. Bosanquet, K.C.), sitting without a jury, a claim was made by Mr. Harry Douglas Marsh, mechanical and electrical engineer, trading as the Central Electric Co., 134 to 138, Newington Butts, against Messrs. Cama Moolla & Co., glass blowers, of Brushfield Street, for the sum of £18 7s. 7d., of which 17s. 7d. was admitted, for certain work and plant the plaintiff had put into the defendants' premises. Mr. Latter was counsel for the plaintiff, and Mr. Eldridge represented the defendants.

According to the plaintiff's case, in July, 1909, the defendants wanted a machine to exhaust the dust and sand from a blast machine and applied to the plaintiff for an estimate for such a machine. The plaintiff gave a quotation to supply such a machine for the sum of £21 15s. This however, did not meet with the approval of the defendants. The defendants then sent the plaintiff an elaborate specification of a machine which they desired to have placed on their premises, and asked the plaintiff how much it would cost to put it there. The plaintiff quoted a sum of £18 7s. The defendants then sent the plaintiff an order to carry out the work which they desired should meet with their approval and the wishes of the Factory Inspector. The plaintiff completed the work in February, and he sent in his bill. The defendants complained that the machine would not do what was required of it, and the plaintiff from time to time adjusted the machine and had tried to meet the defendants' wishes. Eventually, finding that he could not get payment of his account, he placed the matter in the hands of his solicitors.

For the defendants, it was contended that before the plaintiff was entitled to succeed he must show that he had carried out the terms of the contract that the machine would work to their satisfaction and meet the wishes of the Factory Inspector. The plaintiff had done neither. The machine he had installed did not do its work. After hearing the evidence the Common Serjeant thought the fault was with the defendants in pretending to be engineers and able to draw an exact specification, for they had drawn it wrong. Instead of relying upon the plaintiff, they relied upon themselves. The plaintiff carried out the work, but he did not say that he warranted it.

Judgment was entered for the plaintiff for £17 10s. Leave to appeal was granted upon the payment of £40 into Court in seven days.

Business in Russia.—The management of the Russian A.E.G., of St. Petersburg, states that the working results in 1910 proved to be favourable, and it is highly probable that the company will again distribute a dividend of 6 per cent. In general most of German subsidiary companies in Russia obtained good results last year. The favourable harvest indirectly influenced the development of the electrical engineering industry, and the orders showed a considerable increase as compared with 1909, but prices were low in consequence of the competition of the firms who were not so well established. On the other hand, the electrical industry suffers from the circumstance that the municipal authorities only grant concessions accompanied by very stringent conditions.

The Russian newspapers announce that the town of Tambow, which some time ago invited electrical firms to undertake works for the introduction of electric lighting, has now resolved to accept the offer made by the Russian A.E.G. This decision is said to be the more noteworthy, as the price of 247,800 roubles quoted by the A.E.G. was slightly higher than the tender of the Nikolajeff shipbuilding works, which amounted to 242,000 roubles.

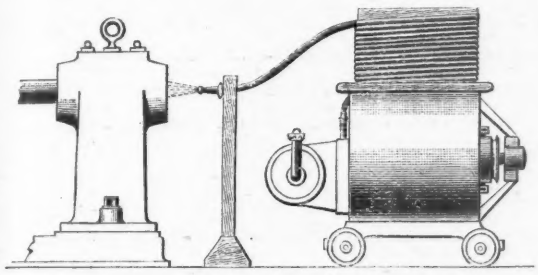
NOVEL CURE FOR A HOT BEARING.

By S. LEES.

Quite recently some electrical machinery which was undergoing specification tests had given considerable trouble with a hot bearing. It was imperative that the test run should be uninterrupted, although much inconvenience had been caused earlier through a shutdown owing to excessive heating of the aforesaid bearing.

But even dog-like watchfulness, and sometimes unlimited libations of lubricant, are not infallible when applied to hot bearings. So—doubtful of the efficacy of the elements mentioned—the writer cast about for a more dependable antidote. It was found in a portable air-compressor which was lying near by, and which ordinarily was employed for cleaning purposes.

The "blower" was rigged up with its discharge nozzle about a couple of feet distant from the erring bearing, and



Cooling a Bearing by an Air-Jet.

regulated so that the current of air projected would not interfere with the proper working of the bearing oil-wells, The subjoined sketch clearly illustrates the fit up.

After a couple of hours' play by the blower the services of the watchman were dispensed with, and the test run was completed without further interruption, the bearing being afterwards taken adrift and adjusted.

SOME CURIOUS TESTS OF CABLE CORE.

By HAROLD OHLSON.

A strange phenomenon was noticed by the writer a few months ago while testing submarine cable core, and some notes on it may prove of interest. Tests for 10 minutes with a battery of 1,500 Leclanché cells were being taken on lengths of core served with yarn and coiled in small iron tanks, each able to contain two lengths of two nautical miles. The tanks were close together, but not in contact, and rested on the floor of the factory, an iron pipe for waste water connecting them at the bottom. Earth was made to this pipe. It was noticed that the first set of zinc to line readings was often, but not always, too high by nearly a constant number of scale divisions; the readings with carbon to line were always correct. An actual test was as follows, the first three readings only being given :—

	Zn to line.	*C to line.*	*Zn to line.*
First minute	251	206	206
Second ,, ...	166	120	120
Third ,, ...	137	91	91

It will be noticed that zinc readings taken after carbon to line had been used were not disturbed. From a number of observations and experiments the following facts were established :—

(*a*) The disturbance was never present except in these small tanks, and was never observed even in them when carbon to line was being used; (*b*) it was usually only the first set of zinc readings that was disturbed, although occasionally subsequent tests were affected; (*c*) the rise in deflection would sometimes suddenly appear after the zinc had been applied for several minutes, a constant deflection being added to the normal; (*d*) a length disturbed on one day might be tested on the next under apparently exactly similar conditions, and a good test obtained; (*e*) these false readings were never noticed with lower battery powers; (*f*) they were invariably much larger when testing the top length in the tank.

From these observations it was deduced that the disturbance only occurred when the tank was raised to the high potential relatively to the core conductor, pointing to an electrostatic effect. From (*f*) it would appear that the disturbance was probably nil on the bottom flake and a maximum on the top, and it was noted that the only connection between the tanks was at the bottom. The remedy was then obvious: the tanks were all joined from rim to rim by copper wire where they approached each other most closely, and the disturbance disappeared. Although some of the phenomena noted are difficult of explanation, the remedy has seemed complete, and the writer offers it in the hope that it may be of service to others whose tests may be disturbed in a similar manner. Briefly, it was found that when testing core with a high-potential battery in tanks not completely sunk in the earth, it is necessary to have metallic connection, *top and bottom*, between all the tanks when they are grouped in a small space.

Electricity in Agriculture.—Modern French and German practice in the use of electricity for agricultural machine driving is discussed in some notes by Herr Krohne in a recent number of the *E.T.Z.*

In the case of ploughing, the blade usually cuts into the soil to a depth rather smaller than the width of the strip turned (in the ratio 1 : 1·2 or 1 : 1·3). Assuming these values, a fairly definite relation exists between the depth turned and the pull required, which may be stated for a single furrow as—

$$\text{Pull in kg.} = \tfrac{3}{4} \times (\text{depth turned in cm.})^2, \text{ or}$$
$$\text{pull in lb.} = 9{\cdot}5 \times (\text{depth turned in inches})^2.$$

This works out at about 44 lb. for a depth of 2 in., 155 lb. for a depth of 4 in., 550 lb. for a depth of 8 in., and 1,330 lb. for a depth of 12 in.

If oxen or horses are used to draw the plough, a continuous maximum drag of about 200 kg. (440 lb.) can be counted upon from a single yoke of animals, 280 kg. (620 lb.) with three animals, 340 kg. (750 lb.) with four, and about 400 kg. (890 lb.) with six animals. The speed with oxen is about ·6 to ·65 metre (2 to 2·15 ft.) per second, and with horses ·65 to ·7 m. per sec. (2·15 to 2·3 ft. per sec.).

Combining these figures, it will be seen that with two horses, four furrows of a depth of 2 in. could be cut together, or two furrows to a depth of 4 in., or a single furrow to a depth of about 6½ in.; whilst for a single furrow 8 in. deep, three horses would be required, and depths over about 10 in. are practically unattainable with animal power. Of course, the above figures can only be approximate as they depend considerably on the nature of the soil and of the stock used.

For the best returns the soil should be turned to depths of 12 in. or 14 in., and, as this is hardly possible with animals, the need for mechanical ploughs becomes apparent. At the same time, it is pointed out that this deep ploughing forms only a small part of the ordinary agricultural work, at least in Germany.

After reviewing the various mechanical ploughs (steam-driven, petroleum-driven, &c.), the writer concludes that the only economical form to use is the rope-driven plough, with speeds of 1 to 1½ metres per second, and cutting four or more furrows at once. The most economical type, and that most simple to manage, is the electrically-driven one, provided that a cheap and ample supply of electricity is available.

Taking a depth of 12 in., the pull required is, as stated above, about 1,330 lb. This will be increased to some 1,750 lb., to cover friction losses. The minimum useful speed is, say, 6 m. (2 ft.) per second. Allowing a gear efficiency of, say, 60 per cent., these figures work out to a motor H.P. of 10 or 12 as the minimum for ploughing work. With this small power, however, the maximum daily area covered would only amount to about 2½ acres, so that larger powers are more likely to prove economical.

Another direction in which an opening for electric driving exists is in connection with threshing operations. At present portable engines of 5 to 8 H.P. are often used, and are able to deal with from 300 to 500 bushels per day. This works out at 100 to 150 watt-hours per bushel.

Electricity can, of course, also be used economically for driving most of the small auxiliary machinery on a farm, and the writer points out the great need for an educational campaign on the subject. He considers that this should be undertaken by the supply authorities, and should be aided by reductions in the price of current to less than 3d. per unit, the hiring out of the necessary agricultural machines, public exhibitions and discussions.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

3,549. "Electric switches." Van Raden & Co., Ltd., and M. Metz. February 13th.

3,558. "Apparatus for continuously and automatically indicating and recording the condition of the insulation of electrical conductors." W. E. Chappell and A. C. Heap. February 13th.

3,571. "Smelting and refining metals and the like in crucibles by means of electrical heating." H. G. Solomon. February 13th.

3,625. "Electric ignition plugs for internal-combustion engines." J. W. T. Cadett. February 13th.

3,630. "Electrical device for receiving and transmitting telegraphic and telephonic messages." E. D. Gledall. February 13th.

3,644. "Control of high-frequency oscillations for use in wireless telegraphy." J. G. Balsillie. February 13th.

3,648. "Electrolytic meters." E. Weintraub. (Convention date, February 14th, 1910, United States.) February 13th. (Complete.)

3,649. "Electrolytic meters." E. Weintraub. (Convention date, February 14th, 1910, United States.) February 13th.

3,701. "Electrical influence machines." Morris & Lister, Ltd., D. K. Morris and E. A. Watson. February 14th.

3,703. "Voltage Regulation." G. A. Burnham. February 14th. (Complete.)

3,705. "Electric switches." Sun Electrical Co., Ltd., J. J. Rawlings and G. Sweetser. February 14th. (Complete.)

3,707. "Double-action electric bell." W. L. Skinley. February 14th.

3,722. "Mounting dynamos on railway and the like vehicles." W. E. Lake. (United States Light and Heating Co., United States.) February 14th. (Complete.)

3,730. "Single-wire telephone systems." C. H. Ellison and W. J. Thorbowgood. February 14th. (Complete.)

3,745. "Resistances for electrical heating and cooking apparatus and other purposes." G. Cooper. February 14th.

3,746. "Electric lampholders." W. Leonard. February 14th.

3,762. "Electric welding or soldering." O. Kjellberg. February 14th.

3,764. "Electric circuit-controlling and protecting devices." British Thomson-Houston Co., Ltd., and E. B. Wedmore. February 14th.

3,774. "Combination side lamp and electric horn." F. L. W. Stapleton, Viscount Combermere. February 15th.

3,779. "Electrical fuse boxes." G. Austin. February 15th.

3,789. "Electric signs." H. Bey. February 15th.

3,794. "Electrical connector." J. H. Harpin and Walker, Horrocks and Co., Ltd. February 15th.

3,821. "Spark plug." L. Podszus. (Addition to 7,617/10. Convention dated October 8th, 1910, Germany.) February 15th. (Complete.)

3,838. "Electrical apparatus for the manufacture and welding of metal articles." S. Jevons. February 15th.

3,839. "Methods of charging and discharging electric accumulators or secondary batteries." A. M. Taylor. (Addition to 22,518/09.) February 15th.

3,859. "Electric sparking plug." L. A. Mazellier. (Convention date, February 17th, 1910, France.) February 15th. (Complete.)

3,865. "Device for the separation of alternating electric discharges." U. Magini. February 15th.

3,867. "Alternating current induction motor." J. Karczewski. February 15th.

3,875. "Magnetic clutches." A. T. Collier. February 15th.

3,877. "Electric switches." British Thomson-Houston Co., Ltd., and E. B. Wedmore. February 15th.

3,883. "Electrical heating and cooking devices." N. Prentice. February 15th. (Complete.)

3,891. "Enclosed arc lamps." Korting & Mathiesen Akt.-Ges. (Convention date, February 21st, 1910, Germany.) February 16th. (Complete.)

3,903. "Cleaning apparatus for tapes on condensers." T. Redshaw & Co. February 16th.

3,918. "Electric fans." M. J. Railing and A. J. D. Krause. February 16th.

3,938. "Intercommunication telephone systems." J. A. Romer. February 16th.

3,946. "Automatic commutator for radio-telegraphic plants with indirect excitation." E. Girardeau. (Convention date July 30th, 1910, Belgium.) February 16th. (Complete.)

3,947. "Radio-telegraphic plant." E. Girardeau. (Convention date December 1st, 1910, France.) February 16th. (Complete.)

3,948. "High frequency alternator for radio-telegraphic and radio-telephonic plants." E. Girardeau. (Convention date May 9th, 1910, France.) February 16th. (Complete.)

3,949. "Sender with direct excitation for radio-telegraphic plants." E. Girardeau. (Convention date July 30th, 1910, Belgium.) February 16th. (Complete.)

3,950. "Electric illuminating bodies." G. Weissmann. (Convention date February 17th, 1910, France.) February 16th. (Complete.)

3,970. "Overground telegraph, telephone and other electric conductors." A. B. Clark. February 16th.

3,978. "Apparatus for giving warning when a train passes a signal placed at danger." Compagnie de Signaux Electriques pour Chemins de Fer. (Convention date, February 21st, 1910, Belgium.) February 16th. (Complete.)

3,996. "Electric conductors." H. Evans and St. Helens Cable and Rubber Co., Ltd. February 16th.

4,000. "Attachment or cover for telephone mouthpieces." A. B. Leete. February 16th.

4,004. "Electric current distributing systems." C. H. Merz and P. V. Hunter. February 16th.

4,008. "Apparatus for generating sound waves and like vibrations in water." E. Klupathy and C. Berger. February 16th. (Complete.)

4,019. "Electric connections and switch control." H. F. Joel. February 17th.

4,050. "Apparatus for perforating the signal controlling tape to be used with automatic telegraph transmitters." W. Judd, A. Frazer and Eastern Telegraph Co., Ltd. February 17th.

4,054. "Dynamo-electric generators and motors." H. K. Whitehorn. February 17th.

4,056. "Hygienic interceptors for telephones." L. B. Claremont. February 17th.

4,062. "Electric lighting device for cycles, motor cycles and motor cars and vehicles." F. von Madaler. February 17th.

4,085. "Magneto electric ignition apparatus for explosive engines." Union Mea G.m.b.H., Elektrotechnische Fabrik Eisenwerk. (Convention date February 17th, 1910, Germany.) February 17th. (Complete.)

4,118. "Connector for electric conductors." M. J. Railing and A. J. D. Krause. February 18th.

4,124. Devices for automatically timing the magneto igniton of internal combustion engines." E. W. Hatfield and H. J. Dean. February 18th.

4,166. "Arc lamps for use in connection with kinematographs and like optical projection apparatus." A. Kershaw. February 18th.

4,191. "Push button circuits for electric controllers." T. Barnard and G. C. Edwards. February 18th. (Complete.)

3,747. "Electric railless trackway with above ground current conductors." H. Sefton-Jones (Oesterreichische Daimler-Motoren-Ges. Akt. Ges. Austria.) (Divided application on 27,798/1910, November 29th.) February 14th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

Controllers for Electric Motors. British Thomson-Houston Co., H. C. Hastings and W. L. Wise. 29,785. December 20th.

Portable Electric Lamp. Electric Export Werke Ges. and F. Gottschalk. 29,789. December 20th.

1910.

Telephone Systems. A. E. Keith. 1,420. January 19th.

Electric Oscillating Systems. E. Wilson and W. H. Wilson. 1,649. January 22nd. (Cognate application, No. 14,918 of 1910.)

Electric Dry Batteries. G. Fuller, G. J. A. Fuller and L. Fuller. 2,300. January 29th.

Electric Clocks. C. Haunz. 2,315. January 29th.

Cable Telegraphy. I. Kitsee. 2,350. January 31st.

Electrical Terminals. R. W. Eldred. 4,466. February 24th.

Electric Distributor or Switchboard for Domestic Electric Cooking, Heating, and like Appliances. H. Gray. 7,882. April 1st.

Electric Arc Lamps. Allgemeine Elektricitäts Ges. 9,209. April 15th. (April 22nd, 1909.)

Electric Arc Lamps of the Projector Type. Westminster Engineering Co. and A. G. Way. 9,215. April 16th.

Electric Illumination Plant for Theatres and the like. T. Weil. 10,043. April 25th.

Electrical Heaters. Evershed & Vignoles, Ltd., A. Schneider and E. Clark. 10,595. April 29th.

Electrical Circuit Closers. A. A. Thornton. (J. T. Clarke.) 11,260. May 6th.

Electrically Lighting Gas-Burners. M. Delage and P. Woog. 11,362. May 7th. (May 7th, 1909.)

Electrically Lighting Gas-Burners. M. Delage and P. Woog. 13,797. June 7th. (Addition to No. 11,362 of 1910.)

Braking Systems for Electric Motor-Driven Vehicles. J. N. Mahoney. 15,896. July 1st. (July 29th, 1909.)

Electrical Power in Collieries: Recent Extensions in the North.—A number of extensions have recently taken place in connection with the supply of electrical power to the collieries in the Northumberland and Durham areas, to which reference may be briefly made.

A new three-core wire-armoured cable has recently been laid from Hesledon to Murton Colliery in connection with the network of the Durham collieries. In connection with this extension, the sub-station at Hesledon, which feeds the Murton Colliery, has had to be enlarged, so that it now contains 5,000 H.P. of plant, there being four transformers of 1,250 H.P. capacity, each receiving the pressure from a main supply of 20,000 volts to a local pressure of 5,750 volts. This sub-station feeds directly into the Murton Colliery, and from thence to various other points in the network of the Durham Collieries Co.

Another extension of mains has taken place in the Easington district, where wire-armoured cables are shortly to be laid for the supply of the Easington Colliery. In connection with this supply, a new sub-station is also about to be built by the County of Durham Electrical Power Distribution Co. at Easington Colliery. This is for the purpose of giving a supply from the mains of the Power Company to act as a stand-by to the Colliery Company's exhaust steam turbine, which is now on order. Ironclad high-tension switchgear is being provided by Messrs. Reyrolle & Co., Ltd., of Hebburn-on-Tyne.

The County of Durham Electrical Power Co., Ltd., has also erected a new sub-station for supplying the Durham collieries at Philadelphia. The ground plan of the building is 25 ft. square, and the structure contains 8,000 H.P., with three-phase transformer manufactured by the Electrical Co., Ltd., there being two transformers in duplicate, each of 4,000 H.P. The voltage at which the sub-station works is 20,000, and the low-tension transformer panels are part of the power station main switchboard.

At the Boldon Colliery of the Harton Coal Co. there has been a considerable increase in the amount of electrical power adopted. Two transformers of 1,250 H.P. each have been installed, replacing two of 600 H.P. The work has been carried out under the supervision of Mr. Maurice Georgi, the engineer to the Colliery Company.

The Washington Coal Co. is about to erect at its Glebe Pit a new electrical sub-station in connection with the use of power for the County of Durham Electrical Power Distribution Co., Ltd., the total capacity of which will be 300 H.P., there being two transformers of 150 H.P., each in duplicate. Each transformer will have its own set of high-tension and low-tension ironclad Reyrolle switchgear of the latest type and design for the mining work.

It will be seen from the above notes that the application of electrical power to mining in the North-Eastern Counties is progressing at a very rapid rate.